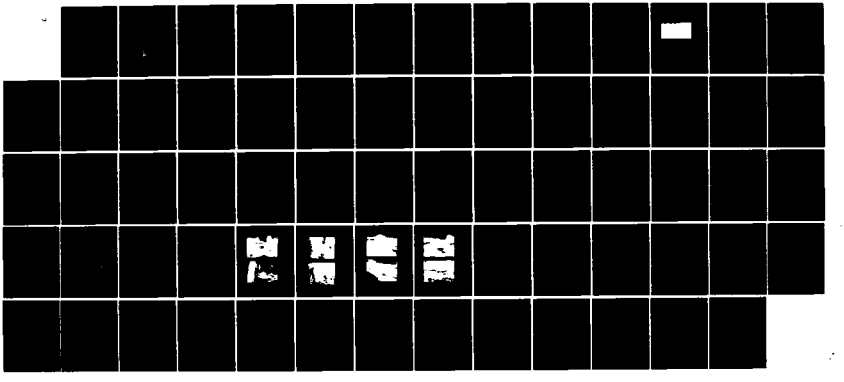
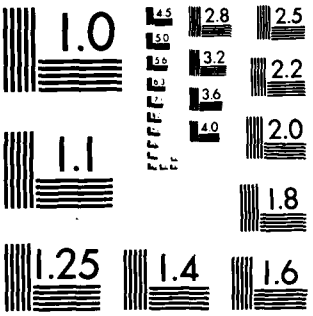
AD-A143 406 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/1
MOUNT HIGBY RESERVOIR..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV FEB 79

UNCLASSIFIED F/G 13/13 NL



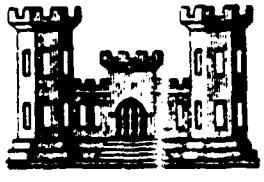


CONNECTICUT RIVER BASIN
MIDDLETOWN, CONNECTICUT

MOUNT HIGBY RESERVOIR DAM

CT. 00140

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

FEBRUARY, 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CT 00140	2. GOVT ACCESSION NO. AD-A143 406	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Mount Higby Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE February, 1979 13. NUMBER OF PAGES 50
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Conn. River Basin
Middletown, Conn.
Mount Higby Reservoir Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Mount Higby Reservoir Dam is an earthfill embankment about 865 ft. long, with a maximum height of about 30 ft. The spillway channel is located at the left abutment and appears to be excavated in bedrock.The test flood inflow is 3,500 cfs., while the outflow is 1,160 cfs. at a surcharge elevation of 366.5, about 0.3 ft. below the top of the dam. The dam is judged to be in generally good condition.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

MOUNT HIGBY RESERVOIR DAM

CT 00140

CONNECTICUT RIVER BASIN
MIDDLETOWN, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No:	CT 00140
Name of Dam:	Mount Higby Reservoir Dam
Town:	Middletown
County and State:	Middlesex County, Connecticut
Stream:	Fall Brook
Date of Inspection:	8 November 1978

BRIEF ASSESSMENT

Mount Higby Reservoir Dam is an earthfill embankment about 865 ft. long, with a maximum height of about 30 ft. The spillway channel is located at the left abutment and appears to be excavated in bedrock. The dam access road crosses the spillway channel via a twin arch masonry bridge between the reservoir and the control sill, and then continues along a berm at the toe of the downstream slope. A wet well outlet structure is connected to a water treatment plant below the dam by means of a buried 20 in. dia. service main. There is also a 36 in. dia. blowoff pipe with an outlet into a natural channel below the dam.

Mount Higby Reservoir is utilized as a water storage facility for the City of Middletown. It is about 6,000 ft. long and has a surface at normal storage of 134 acres. The drainage area is 1.44 sq. mi. and the maximum storage to the top of the dam is 1,750 acre-ft.; the size classification is thus intermediate. Because a breach of the dam could affect the water treatment plant, several homes, a local road and Interstate Highway 91, with the possibility of some loss of life and the probability of serious economic losses, it has been classified as having a significant hazard potential. Based on intermediate size and significant hazard, the test flood is ½ PMF.

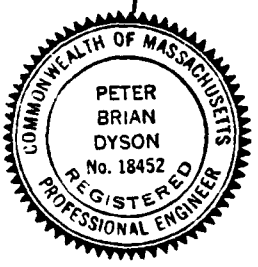
The test flood inflow is 3,500 cfs., while the outflow is 1,160 cfs. at a surcharge elevation of 366.5, about 0.3 ft. below the top of the dam. The spillway is therefore adequate to pass the test flood outflow without overtopping the dam.

The dam is judged to be in generally good condition. Flows of undetermined origin, which may be seepage from the reservoir, appear in the downstream channel and cause two marshy areas below the dam. The dam and appurtenant structures appear to be well maintained, but there is some brush growth and several mature trees on the downstream side of the access road berm.

Within two years of receipt of the Phase I Inspection Report, the owner, the City of Middletown, should retain the services of a competent registered professional engineer, and implement the results of his evaluation of the flows observed in the downstream channel and the two marshy areas below the dam.

The owner should also carry out the following operational and maintenance procedures: (1) Monitor all flows below the dam on a monthly basis for changes in turbidity or volume; (2) Remove scrub from the access road berm and implement a program for gradual removal of all mature trees; (3) Check the 12 in. dia. supplementary inlet control valve for operability; (4) Repair the unserviceable steel slide gate which controls inflows from Adder Reservoir; (5) Develop a formal surveillance and flood warning plan; and (6) Institute procedures for a biennial periodic technical inspection.

Peter B. Dyson
Project Manager



Frederick Esper
Vice President

This Phase I Inspection Report on Mount Higby Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, JR., Member
Chief, Design Branch
Engineering Division

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

	Page
NED LETTER OF TRANSMITTAL	i
BRIEF ASSESSMENT	ii
REVIEW BOARD PAGE	iv
PREFACE	v
TABLE OF CONTENTS	vi
OVERVIEW PHOTO	viii
LOCATION MAP	ix
PHASE I INSPECTION REPORT	
SECTION 1 - PROJECT INFORMATION	
1.1 General	1
1.2 Description of Project	1
1.3 Pertinent Data	5
SECTION 2 - ENGINEERING DATA	
2.1 Design	8
2.2 Construction	8
2.3 Operation	8
2.4 Evaluation	8
SECTION 3 - VISUAL INSPECTION	
3.1 Findings	9
3.2 Evaluation	11
SECTION 4 - OPERATIONAL PROCEDURES	
4.1 Procedures	12
4.2 Maintenance of Dam	12
4.3 Maintenance of Operating Facilities	12
4.4 Warning System	12
4.5 Evaluation	12

Page

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features 13

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability 16

SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment 17
7.2 Recommendations 17
7.3 Remedial Measures 18
7.4 Alternatives 18

APPENDICES

APPENDIX A - VISUAL INSPECTION CHECKLIST

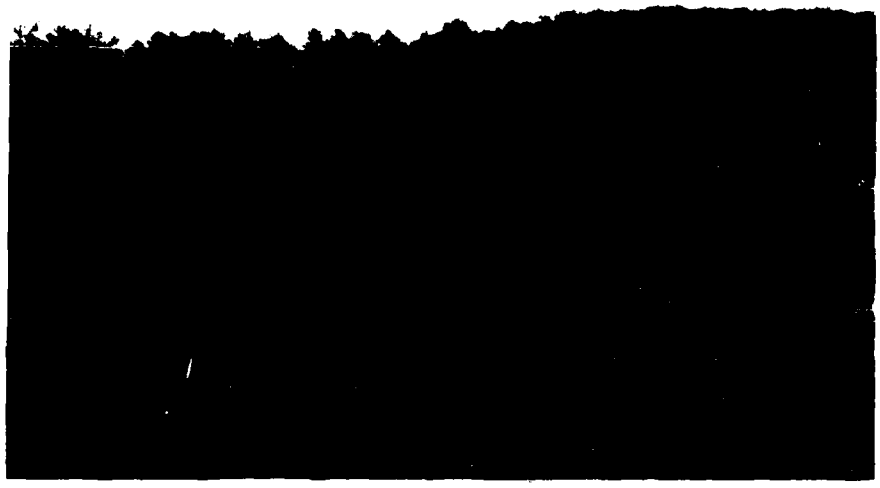
APPENDIX B - PLAN OF DAM

APPENDIX C - SELECTED PHOTOGRAPHS

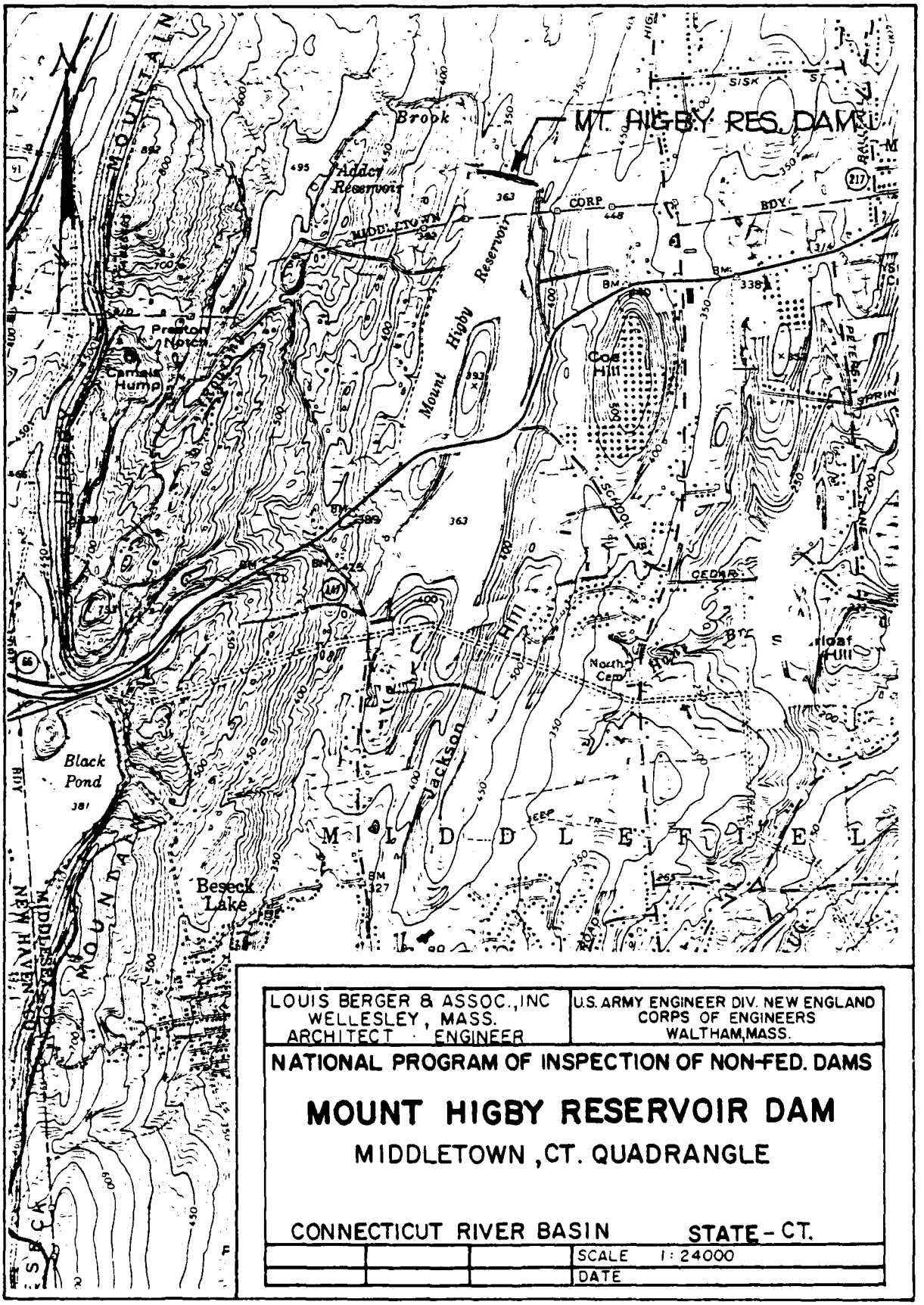
APPENDIX D - HYDROLOGIC & HYDRAULIC COMPUTATIONS

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

MOUNT HIGBY RESERVOIR DAM



Overview from left abutment



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

MOUNT HIGBY RESERVOIR DAM

MIDDLETOWN, CT. QUADRANGLE

CONNECTICUT RIVER BASIN STATE - CT.

			SCALE 1:24000
			DATE

PHASE I INSPECTION REPORT

MOUNT HIGBY RESERVOIR DAM CT 00140

SECTION I - PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 27 October 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0371, Job Change No. 1, has been assigned by the Corps of Engineers for this work.

b. Purpose

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Mount Higby Reservoir Dam is located in the western outskirts of Middletown, Connecticut, at the headwaters of Fall Brook, which is a tributary of Sawmill Brook, the Mattabesset River and the Connecticut River. The dam is reached via State Highway 66, 4.8 miles east from

Meriden, and then ½ mile north on an access road. Normal reservoir water level is 363 MSL, while the confluence of Fall Brook and Sawmill Brook about 2 miles downstream from the dam is 70 MSL. Westfield Falls, located just upstream of the confluence, accounts for approximately 50 ft. of the elevation difference.

The reservoir is operated as a water storage facility to supply water for the City of Middletown. Storages released from Mount Higby Reservoir are drawn into the treatment plant situated about 200 ft. downstream of the dam.

b. Description of Dam and Appurtenances

1. Description of Dam

Mount Higby Reservoir Dam is an earthfill embankment about 30 ft. high at its maximum section and about 865 ft. long. It appears to have been built around the turn of the century. The dam has a concrete core wall, and it is believed that this wall is founded on hardpan and gravel. Both the upstream and downstream slopes are at 2 horizontal to 1 vertical. There is a 22 ft. wide berm at the toe of the downstream slope which carries the access road. The upstream slope is riprapped while downstream the slope is a well maintained, grass furrow slope.

The left abutment appears to be founded on bedrock, as evidenced from rock outcrops along the spillway channel. The right abutment foundation material is not known. Sketch plans and profiles of the dam and appurtenant structures are shown on Figure 1, Sheet D-1, Appendix D.

2. Spillway

The spillway for Mount Higby Reservoir is located at the left abutment and appears to be excavated in bedrock. The approach channel floor is riprapped for approximately 100 ft. and is unlined to the spillway sill some 350 ft. downstream of the reservoir. The left channel wall is steep with exposed rock, while the right channel wall slope is less severe and has random riprap.

The spillway channel entrance is about 100 ft. upstream from the dam centerline. The channel is carried roughly parallel with the dam axis for about 150 ft. into the abutment, where it turns gently about 90 degrees downstream. The channel continues under a twin arch masonry bridge and then to the spillway sill about 100 ft. downstream from the access road bridge. A 2 ft. high and 49 ft. long concrete control sill, placed with its crest 3.6 ft. below the level of the top of the dam, acts to regulate outflows from the reservoir.

A diversion structure, located approximately 1,000 ft. downstream from the spillway sill, releases outflows from Adder Reservoir (located northwest of Mt. Higby Reservoir) either directly into Mt. Higby Reservoir or into Fall Brook. Outflow control is regulated by means of a 6 ft. by 4 ft. 9 in. slide gate at the diversion structure.

3. Outlet

The reservoir outlet is located at about the center of the dam near the low point of the valley. The outlet is a 36 in. dia. pipe, presumably of cast iron, placed through the dam. The control structure, reached by a 50 ft. catwalk extending from the dam crest, houses the inlet to the outlet pipe and the control gate. The 36 in. dia. pipe outlets into a natural channel at an endwall at the downstream toe of the dam. A pipe culvert is located under the trail embankment which leads from the treatment plant parking lot. A 20 in. dia. pipe is the main supply line from the reservoir to the treatment plant located at the toe of the dam. An auxiliary 12 in. dia. line supplies water from the upper reaches of the reservoir beyond the Rte. 66 Causeway to the treatment plant. This 12 in. dia. pipe has not been used for several years. The 20 in. dia. pipe and the 12 in. dia. pipe meet in a concrete chamber box about 30 ft. beyond the toe of the dam, from which a 20 in. dia. pipe supplies water to the plant.

c. Size Classification

Mount Higby Reservoir Dam is about 30 ft. high, impounding a maximum storage of about 1,200 acre-ft. to spillway crest level and about 1,750 acre-ft. to the top of the dam. In accordance with the size and

capacity criteria given in Recommended Guidelines for Safety Inspection of Dams, storage governs and therefore the project is classified as intermediate in size.

d. Hazard Classification

A breach failure of Mt. Higby Reservoir Dam would release water down to Fall Brook, over the Westfield waterfalls, into Sawmill Brook and then into the Mattabesset River, a tributary of the Connecticut River. Four homes, the water treatment plant, part of Country Club Road and part of I-91 could be affected by a flood depth of the order of 10 ft.

It therefore appears that a sudden breach of the dam would probably cause some loss of life and some economic loss. Consequently, Mt. Higby Reservoir Dam has been classified as having significant hazard potential in accordance with the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

Mount Higby Reservoir Dam is owned by the City of Middletown.

f. Operator

Mr. Frank J. Opolacz, Director
Middletown Water & Sewer Department
Municipal Building
Middletown, Connecticut 06457

Telephone: (203) 347-4671

g. Purpose of Dam

Mount Higby Reservoir Dam is operated in conjunction with other water storage facilities, for providing municipal water supplies to the City of Middletown.

h. Design and Construction History

Very little data has been found on the design or construction of the Mount Higby Reservoir Dam. Discussions with City of Middletown personnel indicate that the dam was probably built on hardpan and gravel and that it has either a concrete or masonry core wall. No documentation on design or construction has been recovered.

i. Normal Operating Procedure

There are no written operating procedures. Operators are on duty around the clock at the treatment plant below Mount Higby Reservoir Dam, and are available to periodically regulate the withdrawals from reservoir storage and to check the reservoir conditions. Outlet gate operation at the reservoir is not a day-to-day procedure.

1.3 Pertinent Data

a. Drainage Area

The drainage area contributing to the Mount Higby Reservoir consists of the east side of Higby Mountain, the west sides of Coe Hill and Jackson Hill, the north side of Beseck Mountain and the reservoir area proper, a total of 1.44 sq. mi. (922 acres). The surface area of the reservoir at normal storage elevation 363.2 MSL is 143 acres.

The drainage area measures about 1.5 miles long and 1.0 mile wide and rises to elevation 733 MSL on Higby Mountain. The area is generally forested.

b. Discharge at Damsite

1. Outlet Works Conduit

Discharge from Mount Higby Reservoir is provided by a single 36 in. dia. outlet pipe leading from the gatehouse to a headwall at the toe of the dam. 12 in. and 20 in. dia. pipes supply water from the reservoir to the treatment plant. The release capacity of the 36 in. dia. outlet, with reservoir at normal storage, is estimated at about 150 cfs.

2. Maximum Known Flood at Damsite

No records are available of flood inflows into Mount Higby Reservoir, nor of spillway releases and surcharge heads during such inflows.

3. Ungated Spillway Capacity at Top of Dam

The spillway at Mount Higby Reservoir is an ungated channel with concrete sill control at elevation 363.2 measuring 49 ft. in length. About 100 ft. upstream from the control sill, a twin 18 ft. masonry arch culvert bridge crosses the spillway outlet channel, such that a constriction is formed in the spillway. The capacity at top of dam is about 1,400 cfs at elevation 366.82.

4. Ungated Spillway Capacity at Test Flood Elevation

The spillway capacity at test flood elevation is computed to be about 1,160 cfs at reservoir surcharge elevation 366.5, leaving a freeboard of about 0.32 ft. to top of dam.

5. Total Project Discharge at Test Flood Elevation

The total project discharge at test flood elevation 366.5 is 1,160 cfs.

c. Elevation (ft. above MSL)

1. Streambed at centerline of dam - 336±
2. Maximum tailwater - Unknown
3. Upstream portal invert diversion tunnel - Not applicable
4. Recreation pool - Not applicable
5. Full flood control pool - Not applicable
6. Spillway crest - 363.20
7. Design surcharge - Unknown
8. Top of dam - 366.82
9. Test flood design surcharge - 366.50

d. Reservoir

1. Length at maximum pool - 6,000 ft.±
2. Length of recreation pool - Not applicable
3. Length of flood control pool - Not applicable

e. Storage (acre-feet)

1. Recreation pool - Not applicable
2. Flood control pool - Not applicable
3. Spillway crest pool - 1,177
4. Top of dam - 1,734
5. Test flood pool - 1,680

f. Reservoir Surface (acres)

1. Recreation pool - Not applicable
2. Flood control pool - Not applicable
3. Spillway crest - 134
4. Test flood pool - 165
5. Top of dam - 174

g. Dam

1. Type - Earthfill embankment
2. Length - 865 ft.
3. Height - 30 ft.
4. Top width - 40 ft.
5. Side slopes - 2 horizontal to 1 vertical upstream and downstream
6. Zoning - Presumed concrete or masonry core wall, earthfill upstream and downstream
7. Impervious core - Presumed concrete or masonry core wall
8. Cutoff - Unknown
9. Grout curtain - None indicated
10. Other - Nil

h. Diversion and Regulating Tunnel - None

i. Spillway

1. Type - 350 ft. long channel in rock, 100 ft. riprapped
2. Length of weir - 49 ft.
3. Crest elevation - 363.2 MSL
4. Ungated
5. Upstream channel - Unlined in rock
6. Downstream channel - Unlined, wide grass swale
7. General - 2 ft. high control sill at elevation 363.2 MSL. Twin 18 ft. arch culvert bridge 100 ft. upstream of control sill.

j. Regulating Outlets

1. Invert - Unknown
2. Size - 36 in. dia.
3. Description - Concrete pipe
4. Control mechanism - 36 in. gate at control tower
5. Other - 12 in. dia. and 20 in. dia. lines supply water to treatment plant

SECTION 2 - ENGINEERING DATA

2.1 Design

No data on the design of the dam or appurtenances has been recovered and probably none exist. In the course of the inspection, measurements were taken and a sketch plan and profile layout of Mount Higby Reservoir Dam and appurtenances has been prepared. These sketches are shown on Figure 1 in Appendix D.

2.2 Construction

No records or correspondence regarding construction have been found.

2.3 Operation

The dam is operated by the City of Middletown, Water and Sewer Department. There appear to be no formal records other than reservoir levels.

2.4 Evaluation

a. Availability

Since no engineering data is available, it is not possible to make an assessment of the safety of the embankment. The basis of the information presented in this report is principally the visual observations of the inspection team.

b. Adequacy

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Validity

Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of Mount Higby Reservoir Dam took place on 8 November 1978. The dam appears to be in generally good condition. There was no evidence of any major maintenance problems.

b. Dam

Mount Higby Reservoir Dam has an embankment about 865 ft. long with a maximum height of 30 ft. and a crest width of 40 ft. The horizontal and vertical alignment of the embankment is good. The upstream slope protection is riprapped, which is in generally good condition, except that locally young growth has intruded (Overview Photo). The crest and downstream slope of the dam are grass covered, well maintained and frequently mowed. The berm at the downstream toe of the dam, which carries the access road, is somewhat overgrown; and a few mature trees are established near the right center (Overview Photo). Surface drainage structures are provided for the roadway, but no formal toe drains were evident.

There are two marshy areas, each about 100 ft. downstream of the dam. One of these areas, however, to the right of center of the dam, is about 300 ft. by 400 ft. and appears to be entirely bounded by rock outcrops without a natural drainage outlet. Seepage, therefore, is not considered likely to be a source in this case. The second area is low-lying, to the right of the outlet channel opposite the center of the dam, and upstream of the culvert beneath the embankment of the trail which proceeds eastward from the parking lot by the treatment plant (Appendix C, Photo No. 1). No flow was visible at the time of the inspection. Even if seepage was contributing to this condition, the area is a considerable distance from the dam.

In the channel immediately downstream from the outlet pipe headwall, some standing water was evident, but, the gates being closed, there was no flow (Appendix C, Photo No. 3). It is probable that this water represented the normal ground water table. However, the Supt. of Water Sources advised that, when the reservoir is at normal elevation, there is a distinct trickle of water in this

area. The high velocities of the periodic flushing have scoured the channel near the headwall, exposing a stony bottom. At the culvert under the trail embankment the flow was noticeable, and was said to be of significantly higher velocity and volume at normal reservoir level (Appendix C, Photo No. 2).

c. Appurtenant Structures

The spillway channel is unlined. The first 150 ft. is riprapped and the remainder is in rock cut, which appears to be stable. Some brush growth has established itself in the channel, which might best be grubbed out (Appendix C, Photo Nos. 5 & 6). The riprap at the beginning of the spillway channel appears to be in good condition. The twin masonry arch bridge across the channel requires some grouting but otherwise is in good condition (Appendix C, Photo No. 7). The concrete spillway sill is 2 ft. high, in good condition, and the discharge channel is paved with asphalt for about 50 ft.

There is a 36 in. dia. steel outlet pipe emanating from a headwall located about 30 ft. from the downstream toe of the dam (Appendix C, Photo No. 3). This pipe is used twice a year to flush the outlet structure. It also serves as a means for drawing down the reservoir in emergencies.

At the center of the dam, about 20 ft. from the downstream toe, there is an underground concrete chamber. Here the 12 in. dia. steel supply line from the upper reaches of the reservoir joins the 20 in. dia. steel pipe from the outlet structure. From this point water is routed into the treatment plant via the 20 in. dia. pipe.

The outlet gates at the dam were not operated during the inspection, but according to Middletown Water and Sewer Department personnel, the gates and valves for the 36 in. dia. flushing pipe and 20 in. dia. supply line function properly and have been recently operated. The gate valve for the 12 in. dia. supply line has not been operated for several years but it is believed to be operational.

The gatehouse is a brick structure approximately 10 ft. square surmounting a masonry outlet tower 36 ft. high, and is in good condition. Access to the gatehouse is provided via a steel catwalk from the crest of the dam (Overview Photo).

There is a channel which conveys water from Adder Reservoir into Mount Higby Reservoir, being connected into the spillway channel, upstream of the control sill (Sheet D-1). Flows into Mount Higby Reservoir are controlled by a steel slide gate across the concrete walled channel, which is unserviceable and jammed in the open position (Appendix C, Photo No. 4). When this gate is closed, flows in the channel are diverted over a trapezoidal notch in the concrete wall (Appendix C, Photo No. 8) and reach Fall Brook via a natural channel.

d. Reservoir Area

The shores of the reservoir are gently sloping and, at the immediate water's edge, are riprapped for the greater part of the perimeter. The slopes are stable, as are those of the upstream Adder Reservoir at the base of Higby Mountain.

e. Downstream Channel

Flows from Mount Higby Reservoir discharge into Fall Brook, which runs in a wide valley section. Fall Brook, after passing over the Westfield Falls, empties into Sawmill Brook about 2 miles below the dam. Sawmill Brook continues in a wide valley to its confluence with the Mattabesset River. Valley storage along Fall Brook and Sawmill Brook would not be large, so that large outflows from Mount Higby Reservoir spills could be expected to persist in the downstream valley sections until the Mattabesset River is reached. However, except for the waterway crossing under Interstate 91, damage from large flows along the stream courses would be limited to a local road, about four isolated homes and the water treatment plant.

3.2 Evaluation

The visual inspection has adequately revealed key characteristics of the dam as they may relate to its stability and integrity. The dam and appurtenant works are judged to be in good condition.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The Mount Higby Reservoir facility is operated by personnel of the Middletown Water and Sewer Department, who are stationed at the treatment plant about 100 ft. below the dam. Reservoir operation entails mainly the release of stored water from the reservoir as water supply needs warrant. No minimum releases are required downstream. The outlet from the reservoir to the treatment plant is a pressure pipe, with valves at the outlet of the pipe such that day-to-day regulation of the outlet valve is not required. No documented operating procedures have been prepared.

4.2 Maintenance of Dam

Little maintenance is required except for periodic cutting of the sodded crest and downstream slope. These are well maintained and present an attractive appearance. No documented maintenance instructions have been prepared.

4.3 Maintenance of Operating Facilities

Except for the housekeeping maintenance noted above, no specific maintenance program is in effect. It is presumed that some maintenance to the gates and valves has been performed in the past to keep the mechanisms operative. The gate for the 12 in. dia. supply line, presently in disuse, should be checked and, if necessary, made operative.

4.4 Warning System

No warning system is in effect at Mount Higby Reservoir Dam.

4.5 Evaluation

Although little is known about the construction of the facility, it has simple operating devices and, as such, requires no detailed operating procedures. Maintenance involves periodic growth removal from the embankment and surveillance regarding seeps, slope damage, animal burrows, etc. Outlet operating valves require checking for serviceability. A formal warning and emergency evacuation system should be developed.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General

Mount Higby Reservoir Dam is an earth embankment structure with a concrete core wall impounding a normal storage of about 1,177 acre-ft. with provision for an additional 557 acre-ft. of capacity in its surcharge space to the top of the dam. It is basically a high surcharge-low spillage facility used to supply water to the City of Middletown. The spillway is capable of discharging about 1,400 cfs. with surcharge to the top of the dam.

The general topographic characteristic of the 1.44 sq. mi. (922 acres) drainage basin is best described as rolling terrain. The drainage area measures about 1.5 miles long and 1.0 mile wide and rises from elevation 363.2 at the spillway crest to elevation 733 MSL on Higby Mountain. The area is generally forested.

b. Design Data

There is no design data available for this dam.

c. Experience Data

No records are available in regard to past operation of the reservoir, nor of surcharge encroachments and spills through the spillway. The maximum past inflows are unknown.

d. Visual Observations

There are no present evidences either along the reservoir or in the downstream channel to indicate high water levels or signs of major spillway outflows. No one contacted could recollect any such occurrences.

e. Test Flood Analysis

Reservoir area and capacity curves and tables, for use in flood routings, are shown on Fig. 3, Sheet D-5 and Sheet D-6, Appendix D. For determining surface areas and surcharge capacities, planimetered areas were taken from contours delineated on USGS 2,000 ft. per in. quadrangle sheets.

The test flood chosen to evaluate the hydrologic and hydraulic capacity of Mount Higby Reservoir Dam was selected in accordance with the criteria presented in the Recommended Guidelines for Safety Inspection of Dams. Since this dam is classified as intermediate in size with a significant hazard potential, a test flood of magnitude corresponding to half the Probable Maximum Flood (½ PMF) was selected for the evaluation.

Precipitation data were obtained from Hydrometeorological Report No. 33, which for the Connecticut area approximates 24.3 in. of 6 hour point rainfall over a 10 square mile area. This value was then reduced by 20 percent to allow for basin size, shape and fit factors. The 6 hour rainfall-duration curve of a total of 19.2 in. was then distributed and rearranged as suggested in Design of Small Dams. A constant loss factor of 0.1 in. per hour was deducted from the precipitation values to give the excess rainfall used to prepare an inflow hydrograph.

A triangular incremental unitgraph was assumed for the inflow hydrographs, using a computed lag time value of 0.7 hours to derive a time-to-peak for the triangular hydrograph of 1 hour (see computations on Sheets D-7 and D-8, Appendix D). A PMF inflow hydrograph is shown on Fig. 4, Sheet D-9, Appendix D, indicating a peak inflow of about 6,950 cfs or a CSM of about 4,800.

Spillway discharges are affected by the upstream bridge openings. This was taken into account in computing spillway discharges (see Appendix D, Sheet D-4).

Flood routings were performed for both ½ and full PMF. Results of these routings are shown on Figures 5 & 6, Sheets D-10 and D-11, and are summarized as follows:

Flood Magnitude	Max. Disch. cfs	Max. Res.El. ft.MSL	Max. Head Over Dam ft.	Max. Disch. Over Dam cfs.	Max. Q/ft. Over Dam cfs	Total Outflow Over Dam Ac-Ft	Duration of Overtopping of Dam hrs.
½ PMF	1,160	366.5	0	0	0	0	0
PMF	4,800	367.8	1.0	2,400	280	288	3.50

From the above table, it can be seen that the project will pass the test flood of ½ PMF with about 0.32 ft. of freeboard remaining. The project, however, cannot handle a full PMP flood as the dam would be overtopped by about 1 ft.

Drawdown of the reservoir is possible through the 36 in. dia. flushing pipe. If it were deemed necessary to evacuate the reservoir through this outlet, it is estimated that about 5 days would be required to empty the 1,200 acre-ft. of storage, assuming no inflow in the interim (see computations on Sheet D-12, Appendix D).

f. Dam Failure Analysis

As discussed in Para. d above, the dam would not be overtopped by a 0.5 PMF test flood, but a breach owing to structural failure of the dam by piping or sloughing is a possibility. In that event, a breach similar to that from an overtopping could be assumed and the "rule of thumb" criteria suggested in the NED March 1978 Guidance Report would be applicable. The reservoir level in this instance could be assumed to be lower than at the top of the dam. If the reservoir is assumed to be at normal storage level at the time of the breach, with no flow through the spillway, and a gap eroded to a 20 ft. bottom width with slopes on a 1½ to 1 angle of repose, an outflow of up to about 13,000 cfs could be released (see computations on Sheet D-13, Appendix D).

Fall Brook from Mount Higby Reservoir Dam to Westfield Falls traverses a length of about 11,000 ft. at a slope of about 86 ft. per mile. Based on an average valley cross section, the stream stage for 13,000 cfs will be about 12.5 ft. On this basis, the estimated valley storage for this reach will be about 340 acre-ft., indicating that the flood surge from the gap would be diminished to about 10,000 cfs when it reached the falls area and the waterway under Interstate 91 (see stage-discharge computations on Sheet D-13).

Four isolated homes along local roads crossing and adjacent to Fall Brook and the water treatment plant are within the area of potential flooding (Appendix D, Sheet D-14). Country Club Road would probably be washed out and Interstate 91 and Smith Street might also sustain damage as a result of a breach failure of Mount Higby Reservoir Dam.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation

The field investigations of the embankment revealed no significant displacement or distress which would warrant the preparation of slope stability computations based on assumed soil properties and engineering factors. While the dam proper appeared to be in good condition, it should be reinspected when the reservoir is at its normal elevation, some 7 ft. above the water level at the time of the inspection. Attention should be given to several deficiencies listed in Section 7.

b. Design and Construction Data

No plans, specifications, or construction records are known to exist. Earlier inspection reports by the State indicate only that the dam is, questionably, of "earth and rock fill".

c. Operating Records

There are no operating records of any significance to structural stability.

d. Post Construction Changes

The results of the field inspection and discussions with City of Middletown Water and Sewer Department personnel produced no evidence of changes which might impair stability of the dam.

e. Seismic Stability

The dam is located in Seismic Zone No. 1, and in accordance with recommended Phase I guidelines, does not warrant seismic analyses.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

On the basis of the Phase I visual examination, the Mount Higby Reservoir Dam appears to be in good condition and functioning adequately. The deficiencies revealed are not of major concern, but indicate that further investigations are required. The spillway capacity is adequate to pass the test flood without overtopping the dam.

The serviceability of the valve for the 12 in. dia. inlet pipe is unknown. There are two marshy areas downstream of the dam, one or both of which may be possibly due to seepage derived from the reservoir. There are several mature trees on the downstream slope of the access road berm along the toe of the dam.

b. Adequacy of Information

The lack of in-depth engineering data did not allow for a definitive review. Therefore the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency

The recommendations and remedial measures enumerated below should be implemented by the owner within two years after receipt of the Phase I Inspection Report.

d. Need for Additional Investigations

Additional investigations are required as recommended in Para. 7.2.

7.2 Recommendations

It is recommended that the owner should retain the services of a competent registered professional engineer to make further investigations of the flows in the outlet channel and the causes of the two marshy areas below the dam. These investigations should be carried out during a period of high reservoir level. If proved necessary, suitable remedial works should then be designed and implemented to correct any deficiencies revealed by the investigations.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

1. Monitoring of flows for changes in turbidity or volume should be carried out monthly at the inlet and outlet of the culvert beneath the trail, and at the two marshy areas 100 ft. north of the dam.

2. Scrub should be removed from the downstream slope of the access road berm, and a program for gradual removal of the mature trees in this area should be implemented.

3. The 12 in. dia. supplementary inlet pipe control valve should be checked for operability.

4. The unserviceable steel slide gate which controls inflows from Adder Reservoir should be repaired.

5. A formal surveillance and flood warning plan should be developed. An operational procedure to follow in the event of an emergency should also be adopted.

6. Procedures for a biennial periodic technical inspection of the dam and appurtenant works should be instituted. If possible, these inspections should be conducted during periods of high reservoir level.

7.4 Alternatives

There appear to be no practical alternatives to the above recommendations.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION
PHASE I

Identification No. CT 00140 Name of Dam: Mount Higby Reservoir Dam

Date of Inspection: 8 November 1978

Weather: Cloudy, cold Temperature: 40°F ±

Pool Elevation at Time of Inspection: 356.82

Tailwater Elevation at Time of Inspection: 336.82

INSPECTION PERSONNEL

Pasquale E. Corsetti	Louis Berger & Assoc., Inc.	Acting Project Manager
Carl J. Hoffman	Louis Berger & Assoc., Inc.	Hydraulics, Structures
Thomas C. Chapter	Louis Berger & Assoc., Inc.	Hydrology, Soils
James H. Reynolds	Goldberg Zoino Dunnicliff & Assoc., Inc.	Soils

OWNER'S REPRESENTATIVES

Robert Poole	City of Middletown	Superintendent of Water Sources
William Baron	City of Middletown	Water & Sewer Engineer

VISUAL INSPECTION CHECKLIST

Identification No: CT 00140 Name of Dam: Mount Higby Reservoir Dam Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
EMBANKMENT Vertical alignment and movement	No movement observed.
Horizontal alignment and movement	No movement observed.
Unusual movement or cracking at or near the toe	None observed.
Surface cracks	None observed.
Animal burrows and tree growth	No burrows noted. D/s slope is well kept grass with 3" furrows.
Sloughing or erosion of slopes	None evident.
Riprap slope protection	Upstream face in good condition.
Seepage	Marshy area to right of outlet channel below dam and trail possibly caused by seepage.

VISUAL INSPECTION CHECKLIST

Identification No: CT 00140 Name of Dam: Mount Higby Reservoir Dam Sheet 2

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Piping or boils	None evident.
Junction of embankment and abutment, spillway and dam	Good condition.
Foundation drainage	Unknown.
OUTLET WORKS Approach channel	None.
Outlet conduit concrete surfaces	None.
Intake structure	Gatehouse with wet well.
Outlet structure	Concrete headwall on 36 in. dia. steel pipe.
Outlet channel	Natural unlined channel.

VISUAL INSPECTION CHECKLIST

Identification No: CT 00140 Name of Dam: Mount Higby Reservoir Dam

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Drawdown facilities	36 in. dia. pipe.
SPILLWAY STRUCTURES Concrete weir	24 in. high concrete sill - asphalt approach channel for approx. 50 ft.
Approach channel	Riprapped for approx. 150 ft. at entrance, beyond that random rock excavated in bedrock.
Discharge channel	Natural, meandering grassed valley.
Stilling basin	None.
Bridge and piers	Upstream of crest, 2-18 ft. arch openings.
Control gates and operating machinery	None.

VISUAL INSPECTION CHECKLIST

Identification No: CT 00140 Name of Dam: Mount Higby Reservoir Dam Sheet 4

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
INSTRUMENTATION Headwater and tailwater gages	None.
Embankment instrumentation	None.
Other instrumentation	None.
RESERVOIR Shoreline	Gentle slopes - wooded.
Sedimentation	None observed.
Upstream hazard areas in event of backflooding	Rt. 66 Causeway
Alterations to watershed affecting runoff	None noted.
DOWNSTREAM CHANNEL Constraints on operation of dam	None.

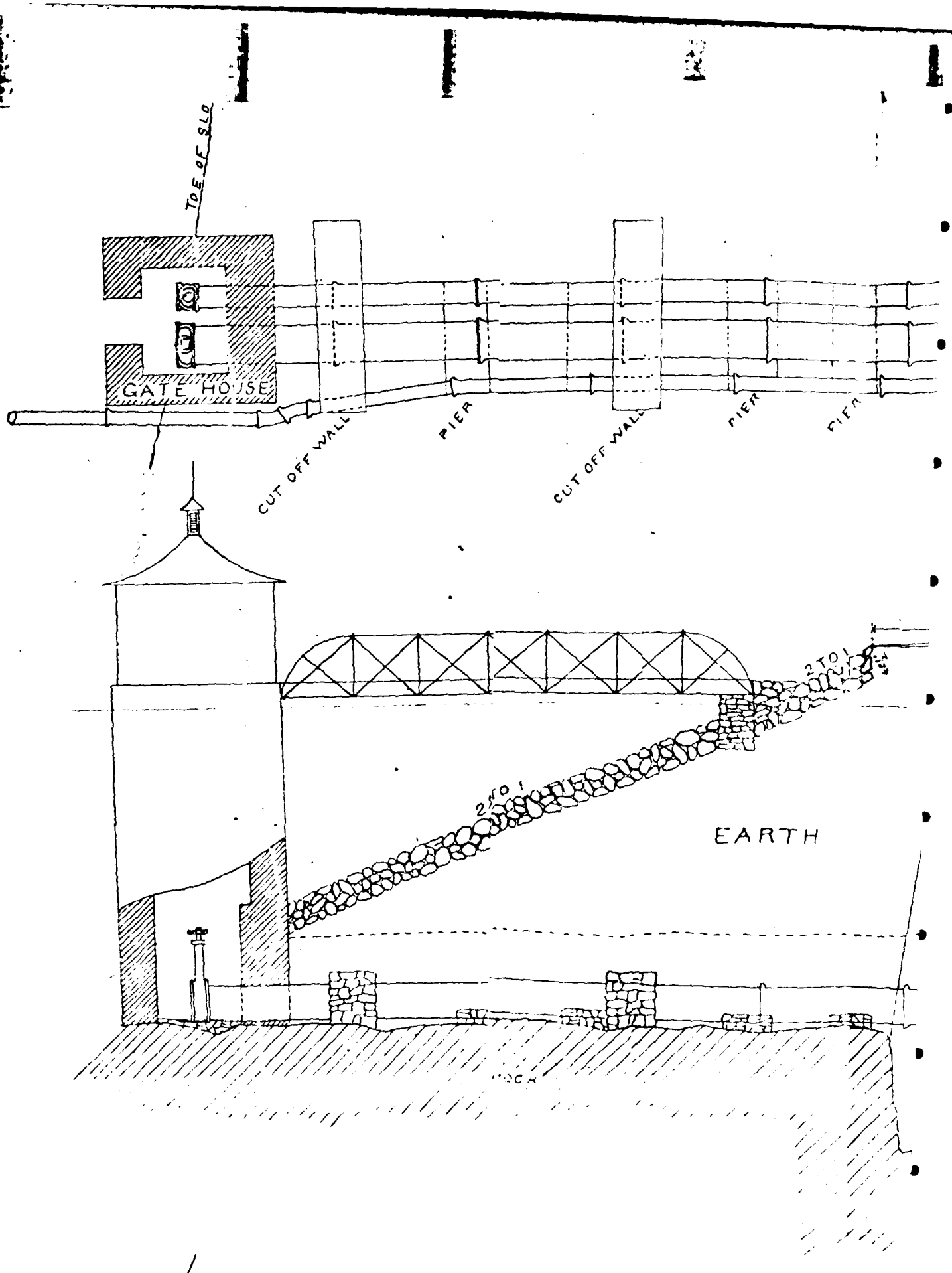
VISUAL INSPECTION CHECKLIST

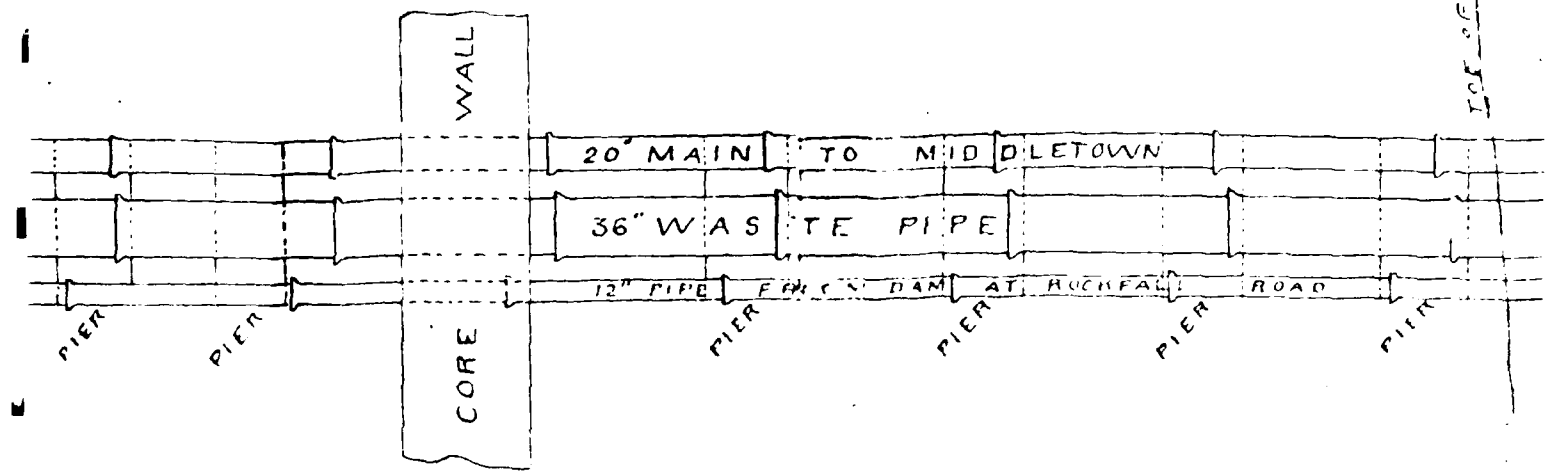
Identification No: CT 00140 Name of Dam: Mount Higby Reservoir Dam

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Valley section	Wide valley, meadowlands and swamps.
Slopes	Gentle.
Approx. No. of homes/population	4 residential homes.
OPERATION AND MAINTENANCE FEATURES Reservoir regulation plan, normal conditions	None.
Reservoir regulation plan, emergency conditions	Divert Roaring Brook (from Adder Reservoir) from Mount Higby Reservoir at downstream control structure.
Maintenance features	Slide gate at downstream control structure inoperable.

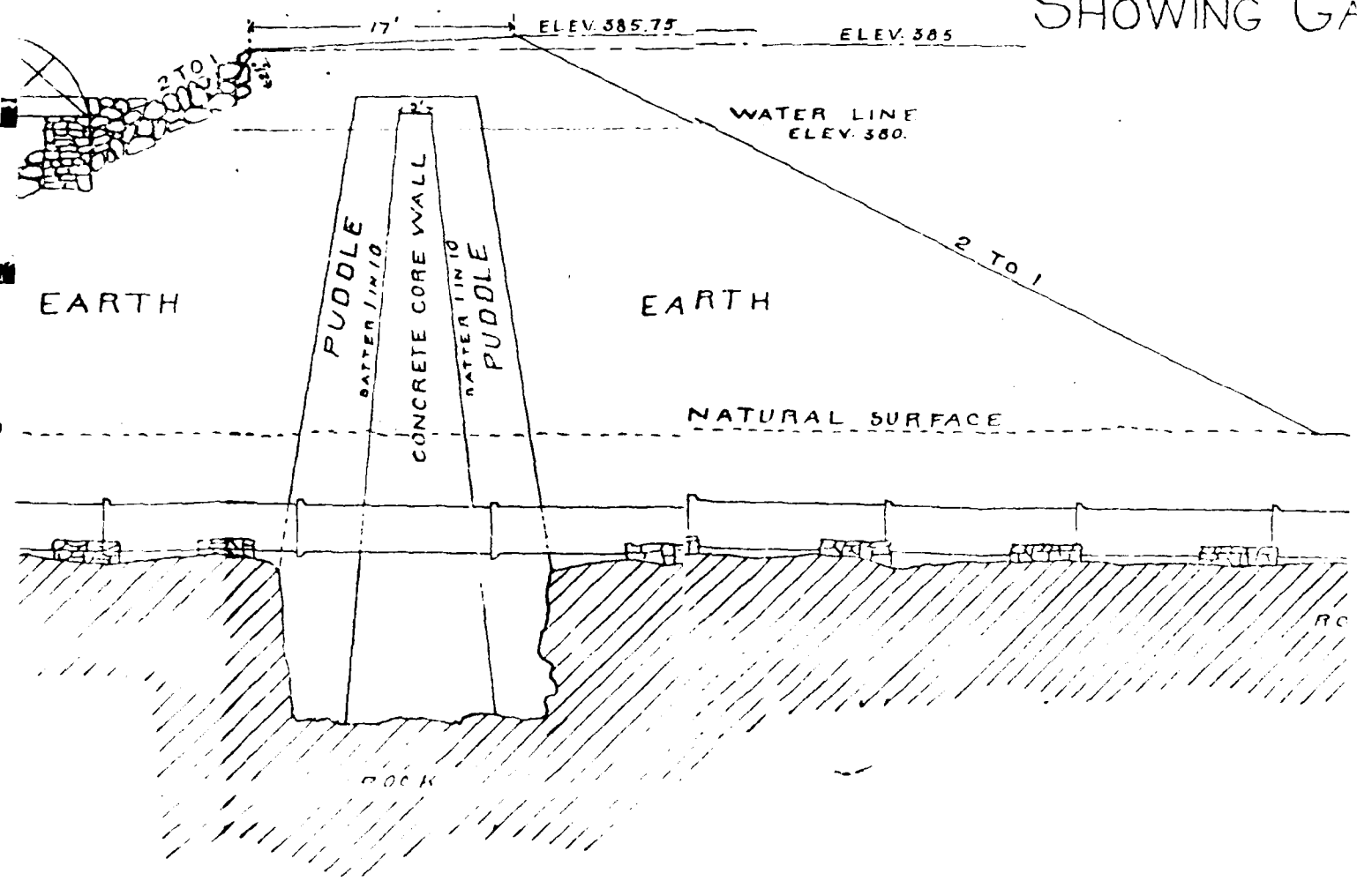
APPENDIX B

PLAN OF DAM

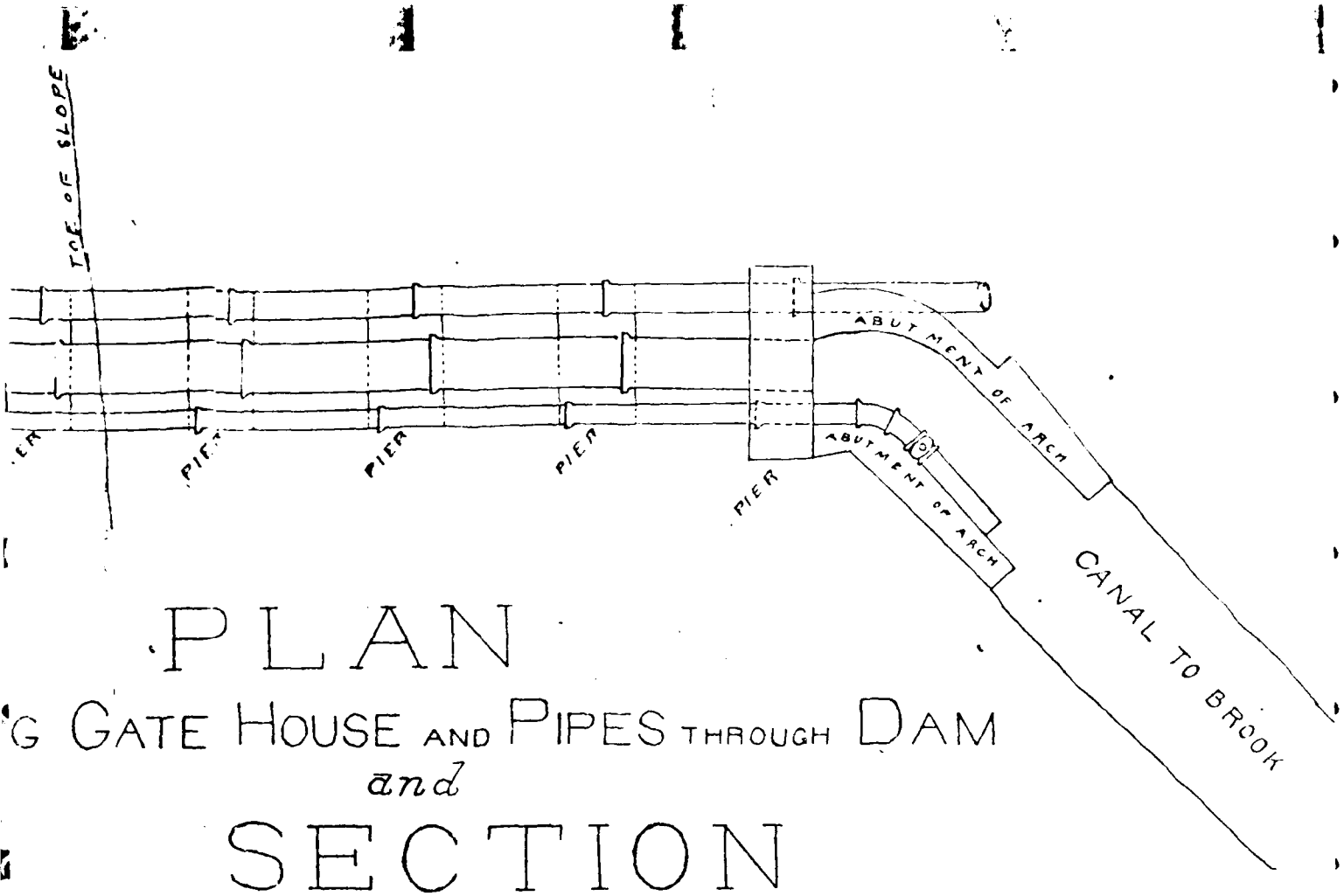

TOE OF SLO
GATE HOUSE
CUT OFF WALL
PIER
CUT OFF WALL
PIER
PIER
2 TO 1
2 TO 1
EARTH
ROCK



SHOWING GA



B-1 2



PLAN

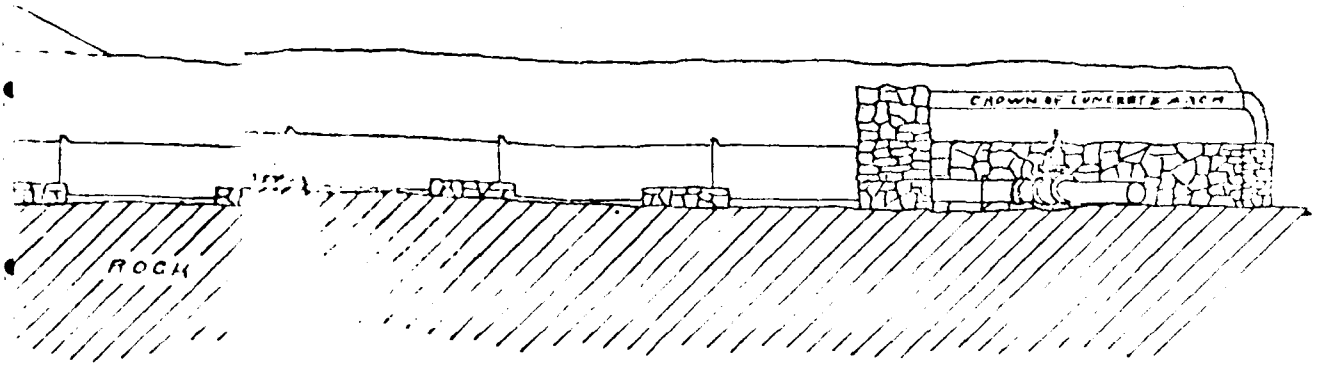
G GATE HOUSE AND PIPES THROUGH DAM

and

SECTION

ON LINE OF 36 INCH PIPE.

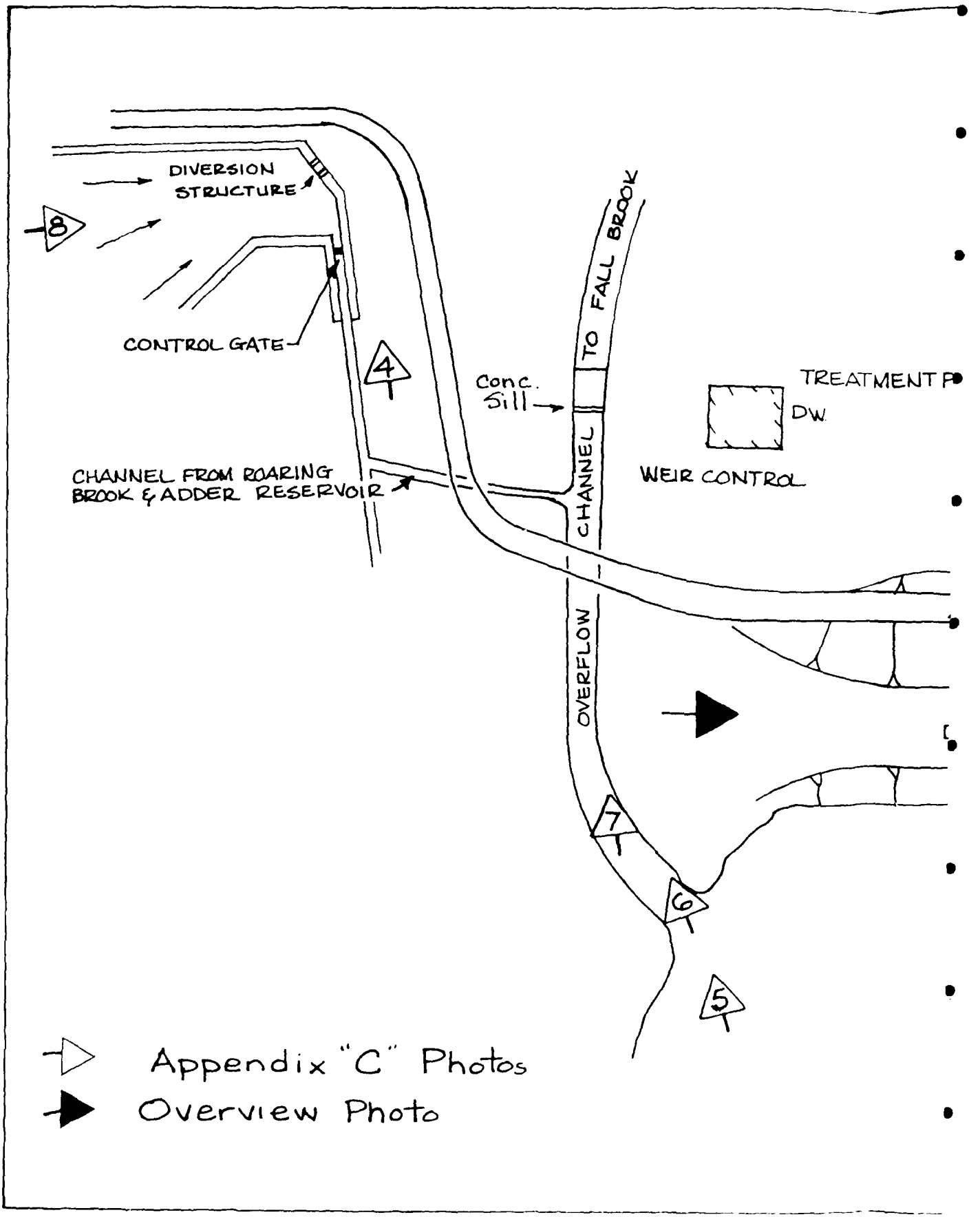
Scale, 1 inch = 10 feet.

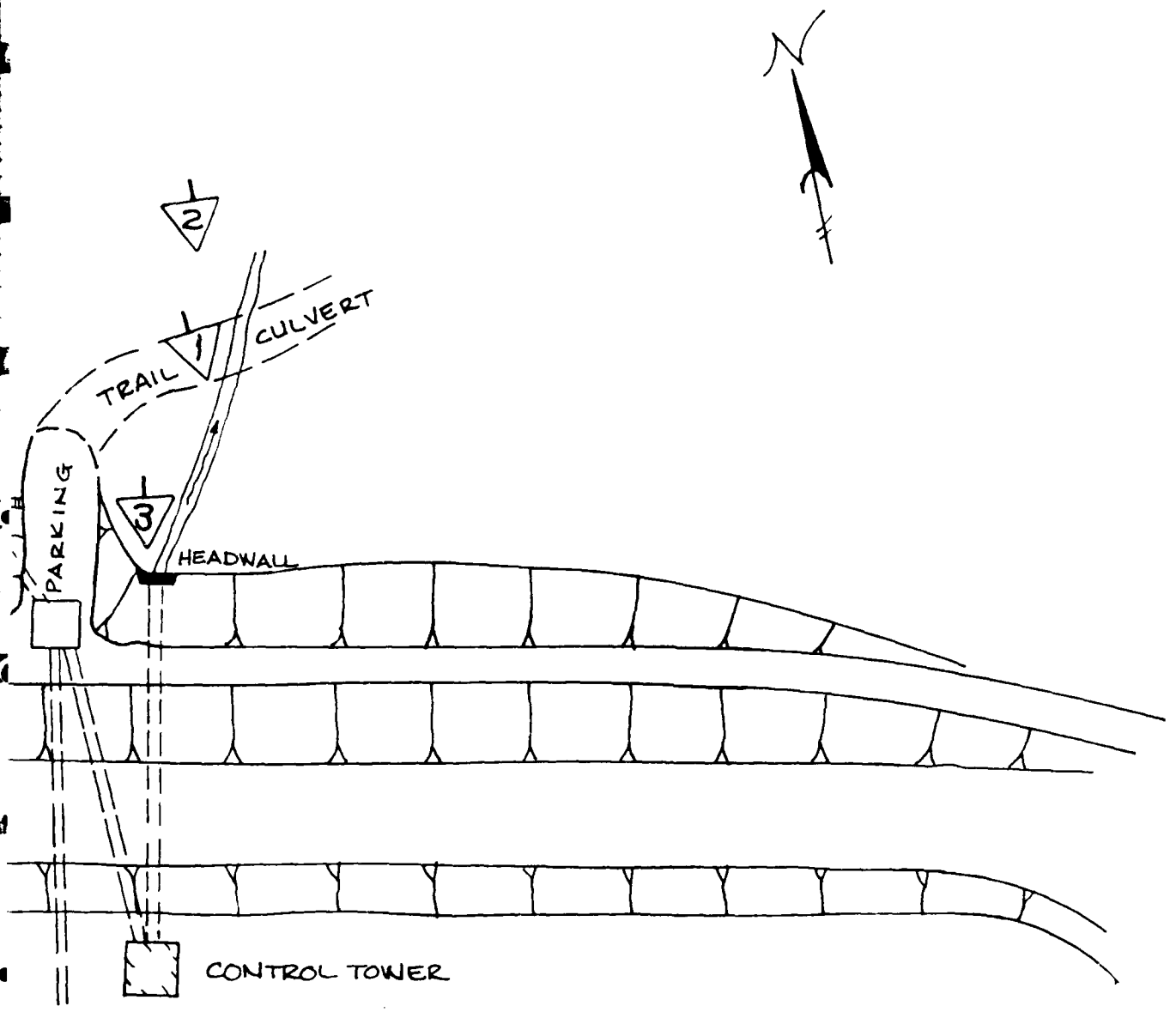


B-1

APPENDIX C

SELECTED PHOTOGRAPHS


DIVERSION STRUCTURE
8
CONTROL GATE
4
Conc. Sill
TO FALL BROOK
TREATMENT P
DW
WEIR CONTROL
CHANNEL FROM ROARING BROOK & ADDER RESERVOIR
CHANNEL
OVERFLOW
7
6
5
Appendix "C" Photos
Overview Photo



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

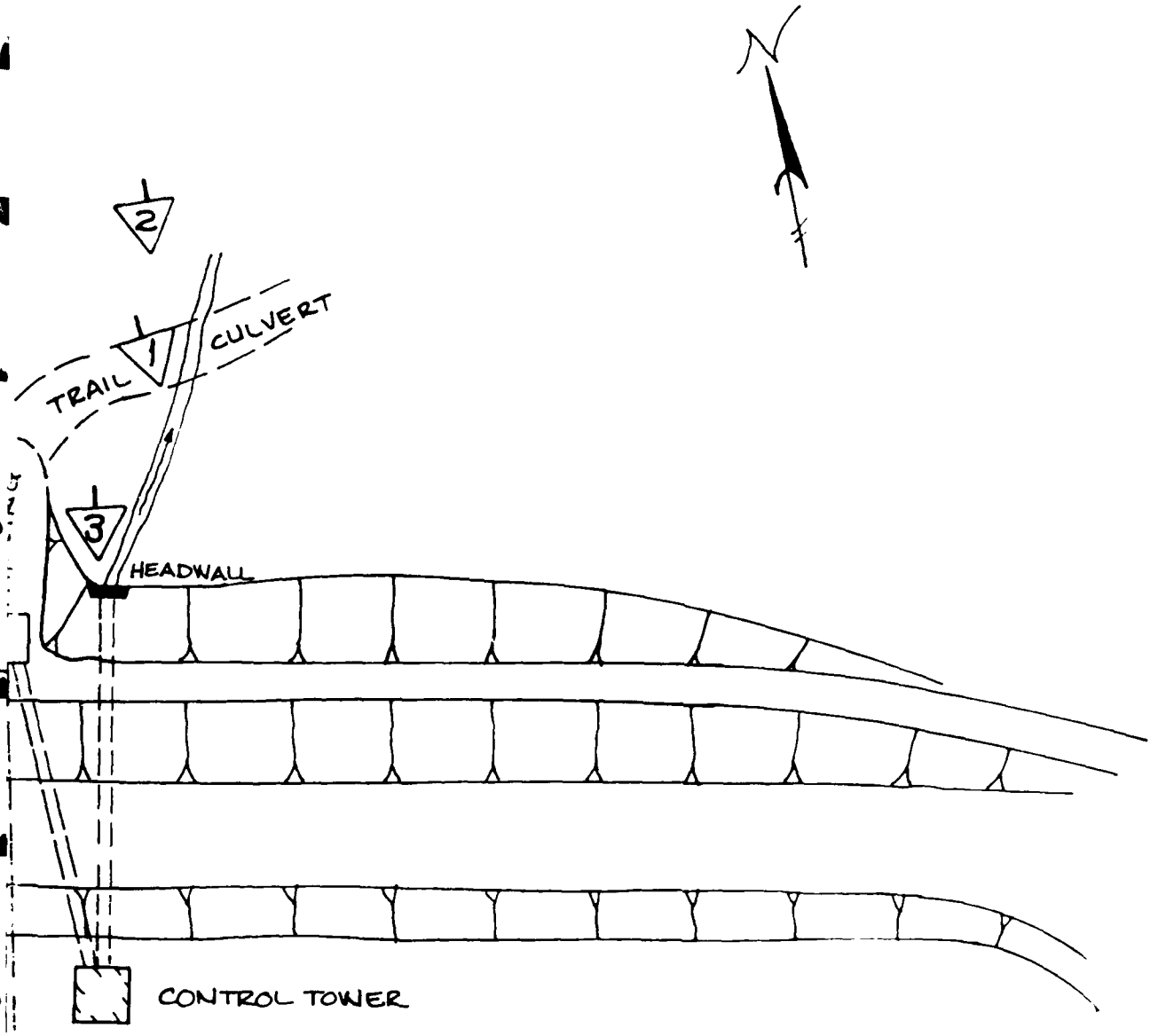
MOUNT HIGBY RESERVOIR DAM

SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS

STATE - CT.

			SCALE
			DATE

HIGBY
RVOIR



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS ARCHITECT - ENGINEER	US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

MOUNT HIGBY RESERVOIR DAM

SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS

STATE - CT.

			SCALE
			DATE

HIGBY
JOIR

MOUNT HIGBY RESERVOIR DAM

1. Marsh opposite right center of dam, looking upstream.

2. Outlet channel culvert under trail below dam.

3. Headwall on 36 in. dia. outlet pipe.

4. Steel slide gate on channel from Adder Reservoir.

MOUNT HIGBY RESERVOIR DAM

5. Spillway approach channel

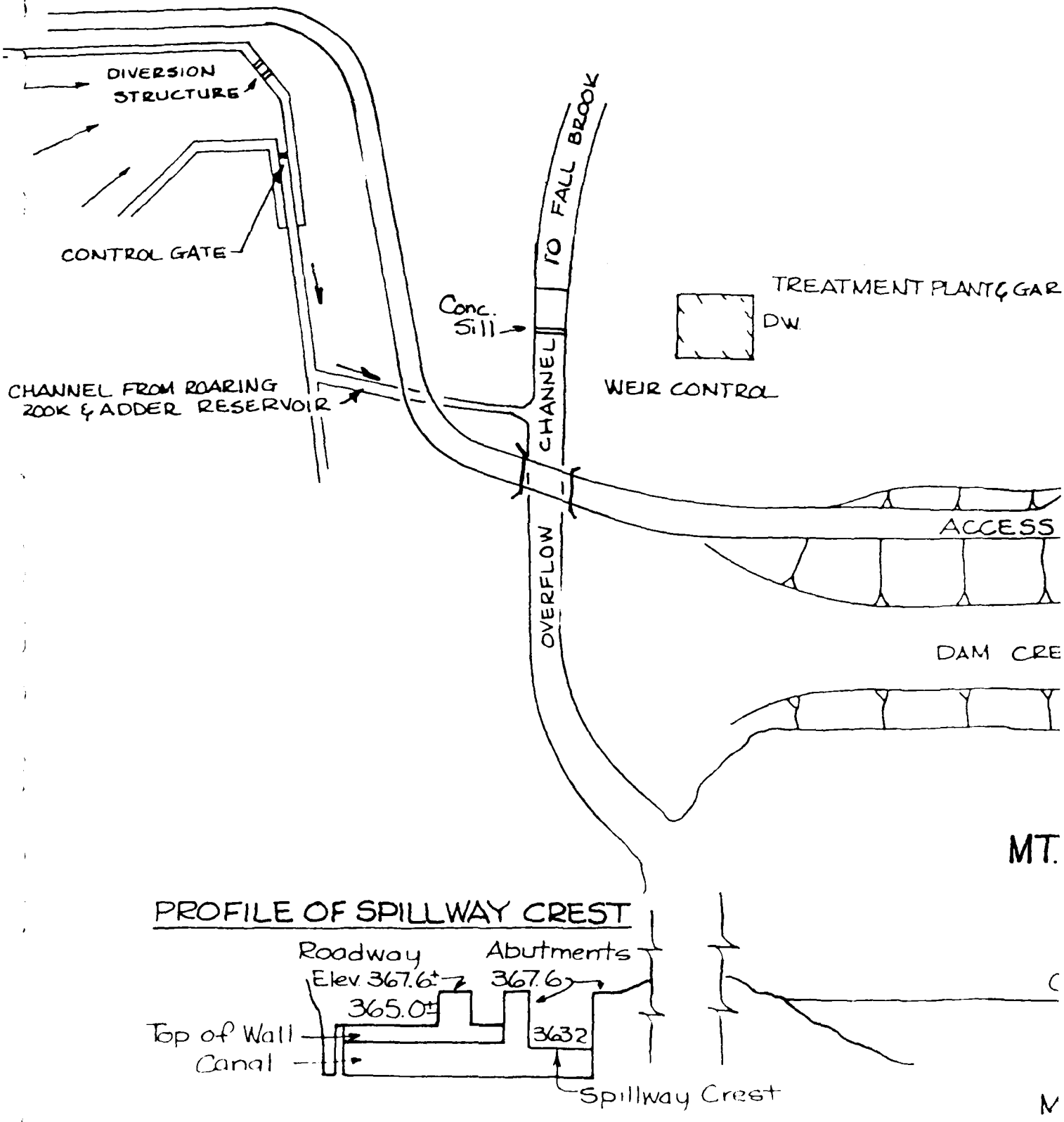
6. Spillway approach channel

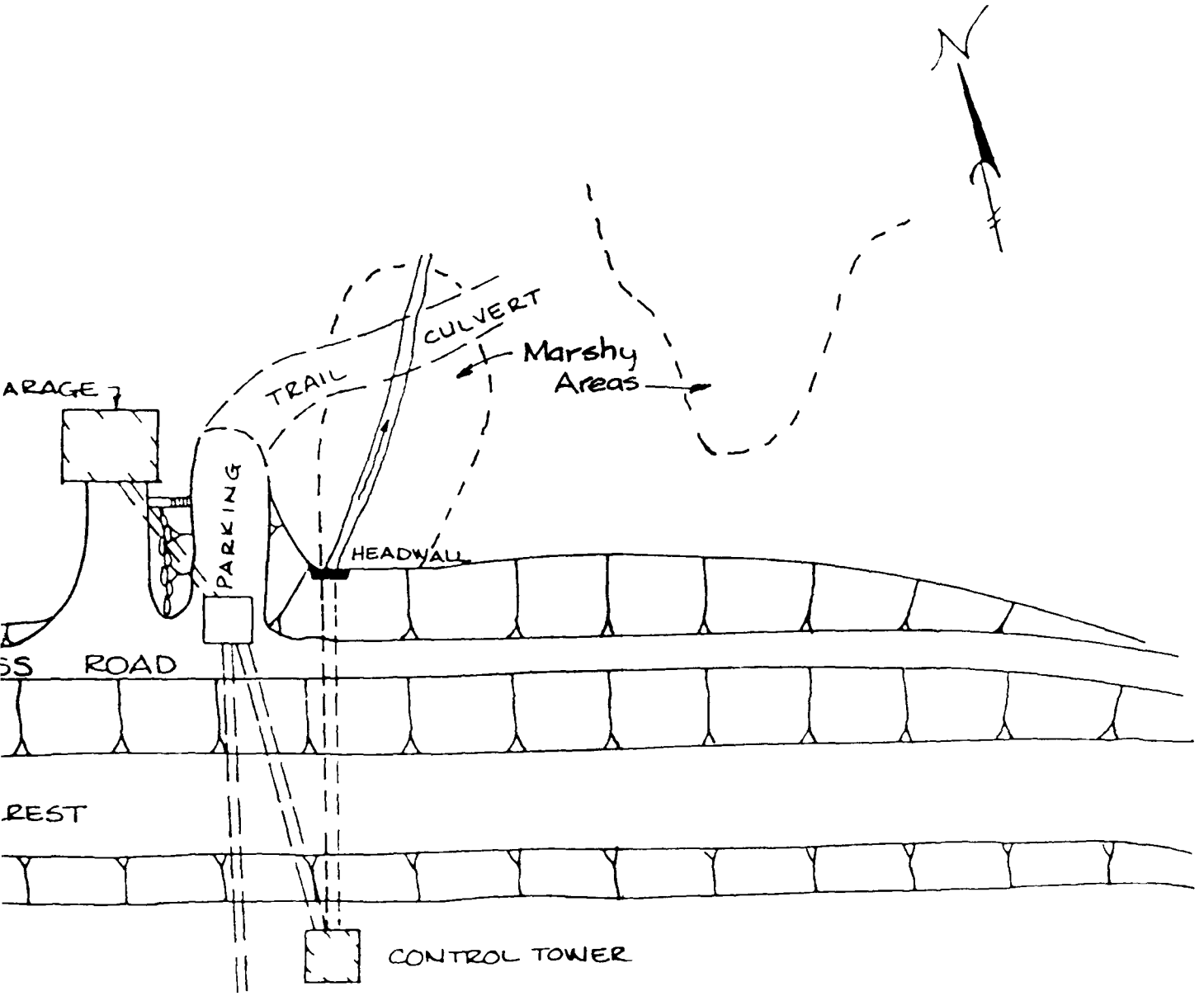
7. Twin arch culvert carrying access road across spillway approach channel

8. Trapezoidal notch for diverting inflows from Adder Reservoir

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS


DIVERSION STRUCTURE
CONTROL GATE
CHANNEL FROM ROARING BROOK & ADDER RESERVOIR
Conc. Sill
TO FALL BROOK
CHANNEL
OVERFLOW
TREATMENT PLANT & GAR
DW.
WEIR CONTROL
ACCESS
DAM CRE
MT.
PROFILE OF SPILLWAY CREST
Roadway
Elev. 367.6±
Abutments
367.6
365.0±
Top of Wall
Canal
3632
Spillway Crest



T. HIGBY RESERVOIR
(Not to Scale)

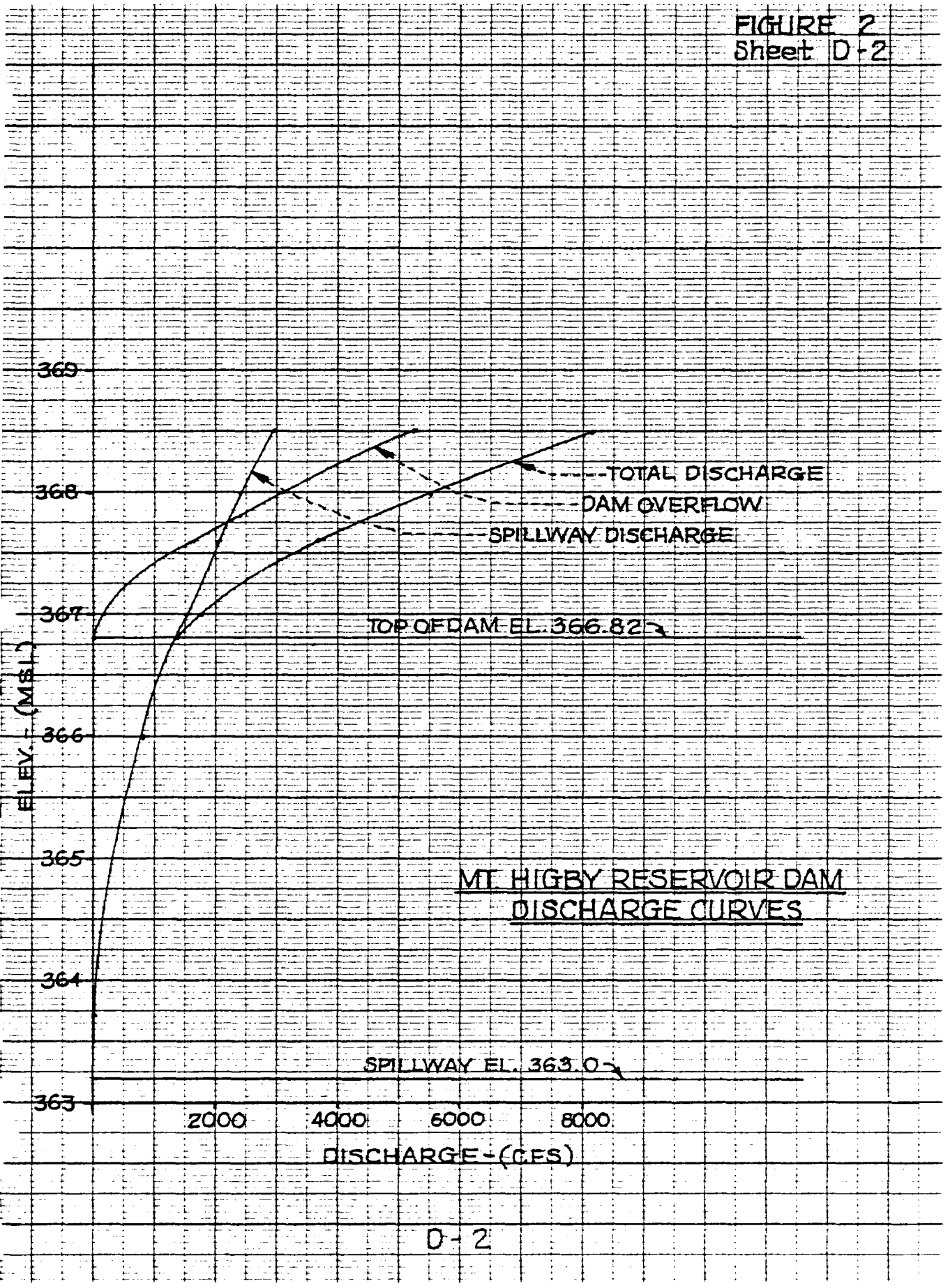
Crest of Dam - Elev. 3666.82

PROILE OF DAM

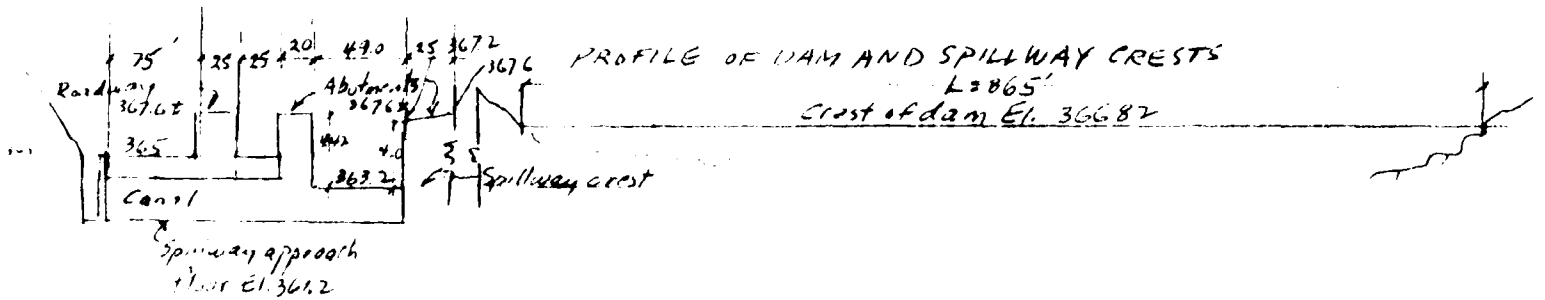
MT HIGBY RESERVOIR DAM

SKETCH PLAN & PROFILE
FIGURE 1 - SHEET D-1

FIGURE 2
Sheet D-2



MT. HIGBY RESERVOIR DAM
DISCHARGE CURVES



PROFILE OF DAM AND SPILLWAY CRESTS
L = 865'
Crest of dam El. 366.82

Elev	SPILLWAY CREST L=49' H	C	ΔQ	Spillway Abutment @El 365± L=25' H	C	ΔQ	Canal bank @El 365± L=75' H	C	ΔQ	Spillway road + Abutm. L = ±70 H	C	ΔQ	Total for Spillway ΔQ	Dam overtopping Crest @El 366.82 H	C	ΔQ	Total outflow ΣQ
363.2	0	3.08	0										0				0
363.7	0.5	2.95	51										51				51
364.2	1.0	2.90	142										142				142
365.0	1.8	2.68	317	0	2.4	0	0	-	0				317				317
365.5	2.3	2.58	441	0.5	2.3	20	0.5	2.4	64				525				525
366.0	2.8	2.48	569	1.0	2.25	56	1.0	2.5	188				813				813
366.5	3.3	2.40	705	1.5	2.15	99	1.5	2.6	358				1162				1162
366.82	3.62	2.34	791	1.82	2.10	129	1.82	2.6	479				1378	0			1398
367.0	3.80	2.30	835	2.0	2.05	145	2.0	2.6	551				1531	0.18	2.8	185	1716
367.6	4.40	2.21	999	2.6	2.00	210	2.6	2.6	816	0			2027	0.78	2.8	1668	3695
368.0	4.80	2.14	1103	3.0	1.90	247	3.0	2.6	1013	0.4	2.4	42	2405	1.18	2.8	3105	5510
368.5	5.30	2.05	1226	3.5	1.85	303	3.5	2.6	1279	0.9	2.5	149	2957	1.68	2.8	5274	8131

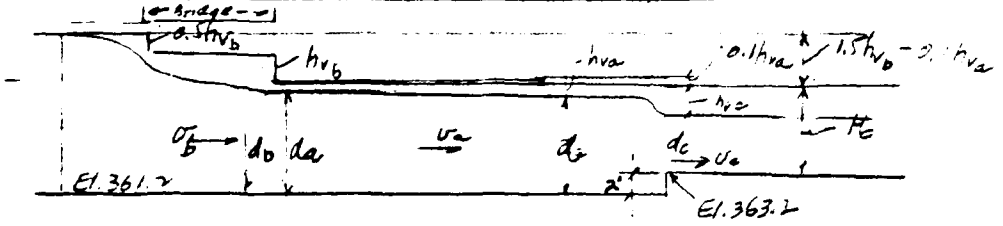
BY CAT DATE 1-2-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-4 OF

CHKD. BY DATE INSPECTION OF DAMS - CONN. R. PROJECT W-189

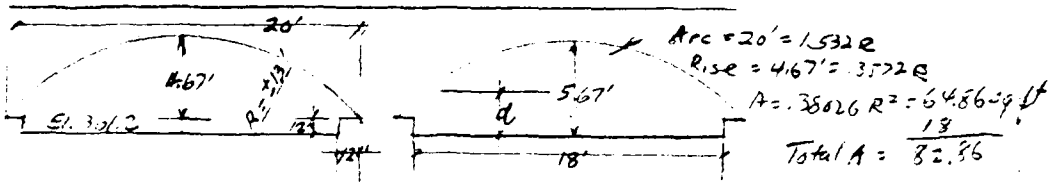
SUBJECT MT. HIGBY RESERVOIR DAM - SPILLWAY DISCHARGE

SPILLWAY - Broadcrest @ El 363.2 width 49'

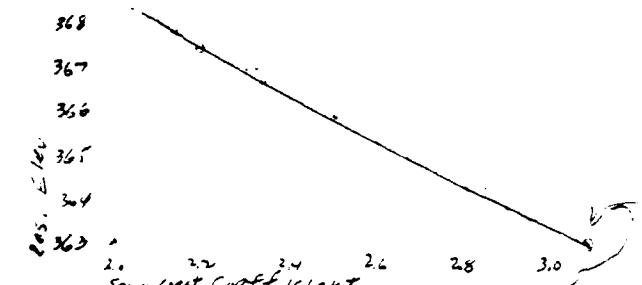
Effect of upstream bridge on discharges



Bridge openings

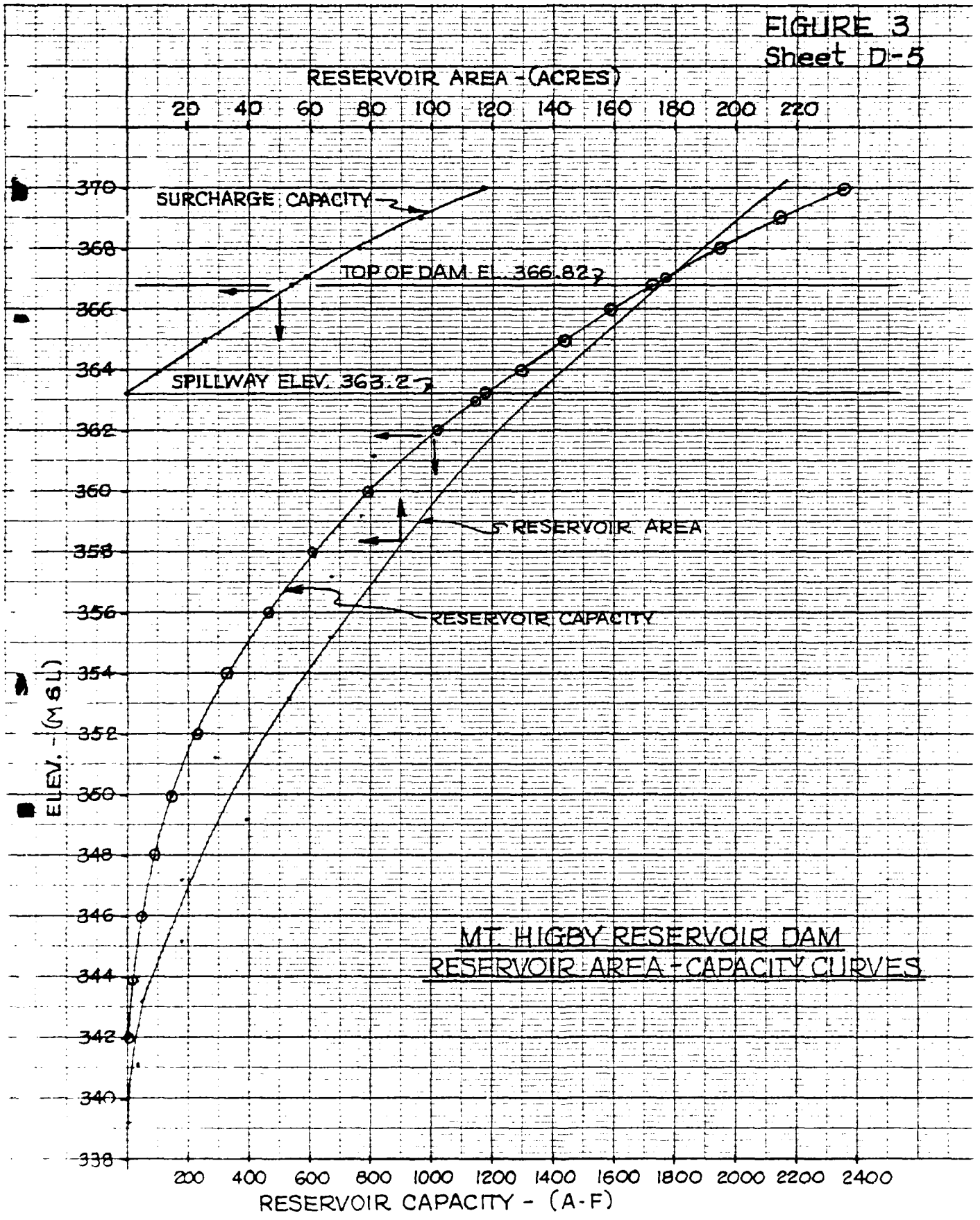


Depth d	Area
1.0	18.0
2.0	37.05
2.5	45.83
3.0	54.25
4.0	68.4
4.5	74.25
5.0	79.25



Q	$H_e = (\frac{Q}{3.09L})^{2/3}$	$H_a = 2.0$	Approach $A = 49(H_a - 2)$	$V_a = Q/A$	hv_a	$0.1 hv_a$	d_a	A_b = Area under bridge	$V_b = Q/A_b$	hv_b	$1.5 hv_b$	$H_e + 1.5 hv_b + 0.1 hv_a$	Effective Coeff.	Reservoir Elev.	Remarks
100	0.76	2.76	135.2	0.74	0.01	0	2.76	100.3	1.00	.016	0.03	0.79	2.90	363.99	
200	1.20	3.20	156.8	1.27	0.025	0	3.20	114.14	1.75	.048	0.07	1.27	2.85	364.47	
400	1.91	3.91	191.9	2.09	0.068	.007	3.917	134.67	2.97	.137	.205	2.12	2.64	365.32	
600	2.50	4.50	220.7	2.72	0.115	.011	4.571	150.62	3.98	.246	.370	2.88	2.51	366.08	
800	3.03	5.03	246.6	3.24	0.163	.016	5.046	158.48	5.05	.396	.594	3.64	2.34	366.84	Top flash
1000	3.52	5.52	270.5	3.70	0.212	.021	5.541	164.07	6.09	.577	.865	4.41	2.20	367.5	
1100	3.75	5.75	281.8	3.90	0.237	.024	5.774	165.72	6.63	.684	1.026	4.80	2.13	368.0	

FIGURE 3
Sheet D-5



MT HIGBY RESERVOIR DAM
RESERVOIR AREA - CAPACITY CURVES

A

BY PEC DATE 1/25/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-6 OF

CHKD. BY DATE DAM INSPEC. PROJECT

SUBJECT MT. HIGBY RESERVOIR

AREA - CAPACITY CURVES

Elev	AREA (acres)	AV. AREA (acres)	H	Δ STOR (A-F)	Σ STOR (A-F)	SURCHARGE STOR. (A-F)	REMARKS
338	0	0					
340	2	1	2	2	2		
342	5	3.5	2	7.0	9		
344	10	7.5	2	15.0	24		
346	16	13.0	2	26.0	50		
348	24.5	20.25	2	40.5	90.5		
350	35	29.75	2	59.5	150.0		
352	46	40.5	2	81.0	231.0		
354	58	52.0	2	104.0	335		
356	72	65.0	2	130.0	465		
358	86	72.0	2	144.0	609		
360	103	94.5	2	189.0	798		
362	122	112.5	2	225.0	1023		
363.0	132	127.0	1	127.0	1150		Spillway Crest
363.2	134	133.0	0.2	26.6	1176.6	0	elev. 363.2
364	143	138.5	0.8	110.8	1287.4	110.8	
365	154	148.5	1	148.5	1435.9	259.3	
366	165	159.5	1	159.5	1595.4	418.8	Top of Dam
366.82	174	169.5	0.82	139.0	1734.4	557.8	Elev 366.82
367.0	175	174.5	0.18	31.4	1765.8	589.2	
368	189	182.0	1	182.0	1947.8	771.2	
369	201	195.0	1	195.0	2142.8	966.2	
370	214	207.5	1	207.5	2350.3	1173.7	

BY GH STS DATE 12/5/78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-7 OF

CHKD. BY PEC DATE INSPECTION OF DAMS - CONN + RI PROJECT

SUBJECT MT HIGBY RESERVOIR DAM - HYDROLOGY #11

DRAINAGE AREA - 1.4409 mi² = 922 acres

Reservoir area 134 acres @ El 363 Res area = 15% of Total

Reservoir capacity at Normal storage = 1148 AF

Spillway crest El. 363.2 Res. Length 6000'

Res Width 1000'

Drainage area

Length = 1.4 mi. width = 1 mile

Tributary flow.

Longest course 5400' H = 540 - 363 = 177'

= 1.02 miles S = .033 or 174'/mile

Say Curve A Use K = 2.0

$$Lag = K\left(\frac{L L_c}{\sqrt{S}}\right)^{.33} = 0.34\ K$$

Lag = 2 × 0.34 = 0.68 hrs D = 0.5 hour.

T_p = 0.82 Lag + .4 D = 0.55 - 0.2 = 0.75 hrs

Check on velocity

Ave. Length 5400' $V = \frac{\text{Length}}{3600 \times \text{Lag}} = \frac{5400}{3600 \times .68} = 2.2'/\text{sec}$

For S = .033. USNavy T.P Handbook TP-PW-2

ave V = 3.0 ? 2.2'/sec about

Texas Hwy Dept Sept '65

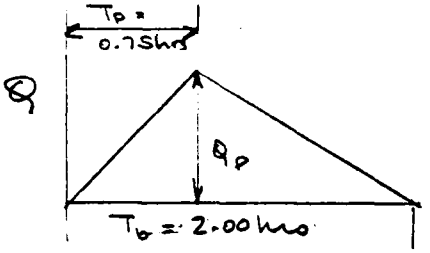
ave. V = 1 to 3'/sec

T_p = 0.82 Lag + .40 for D = 1.0 hr.

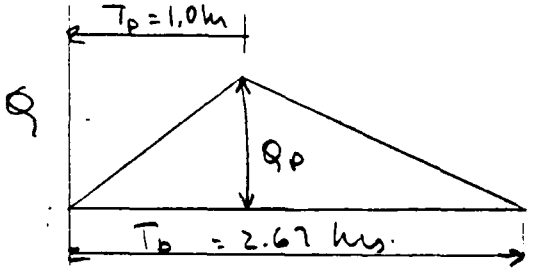
= 0.82(.68) + .4 = 0.96 Say 1.0

Develop TRIANGULAR UNIT GRAPHS FOR

D = 0.5 hrs.



D = 1.0 hrs



$$Q_{p\,(T_p=1.0)} = \frac{484(A)(Q)}{T_p} = \frac{484(1.44)(1.0)}{1.0} = 696 \text{ cfs}$$

$$Q_{p\,(T_p=.75)} = \frac{484\,A\,Q}{T_p} = \frac{484(1.44)(1.0)}{(0.75)} = 929 \text{ cfs}$$

Rainfall

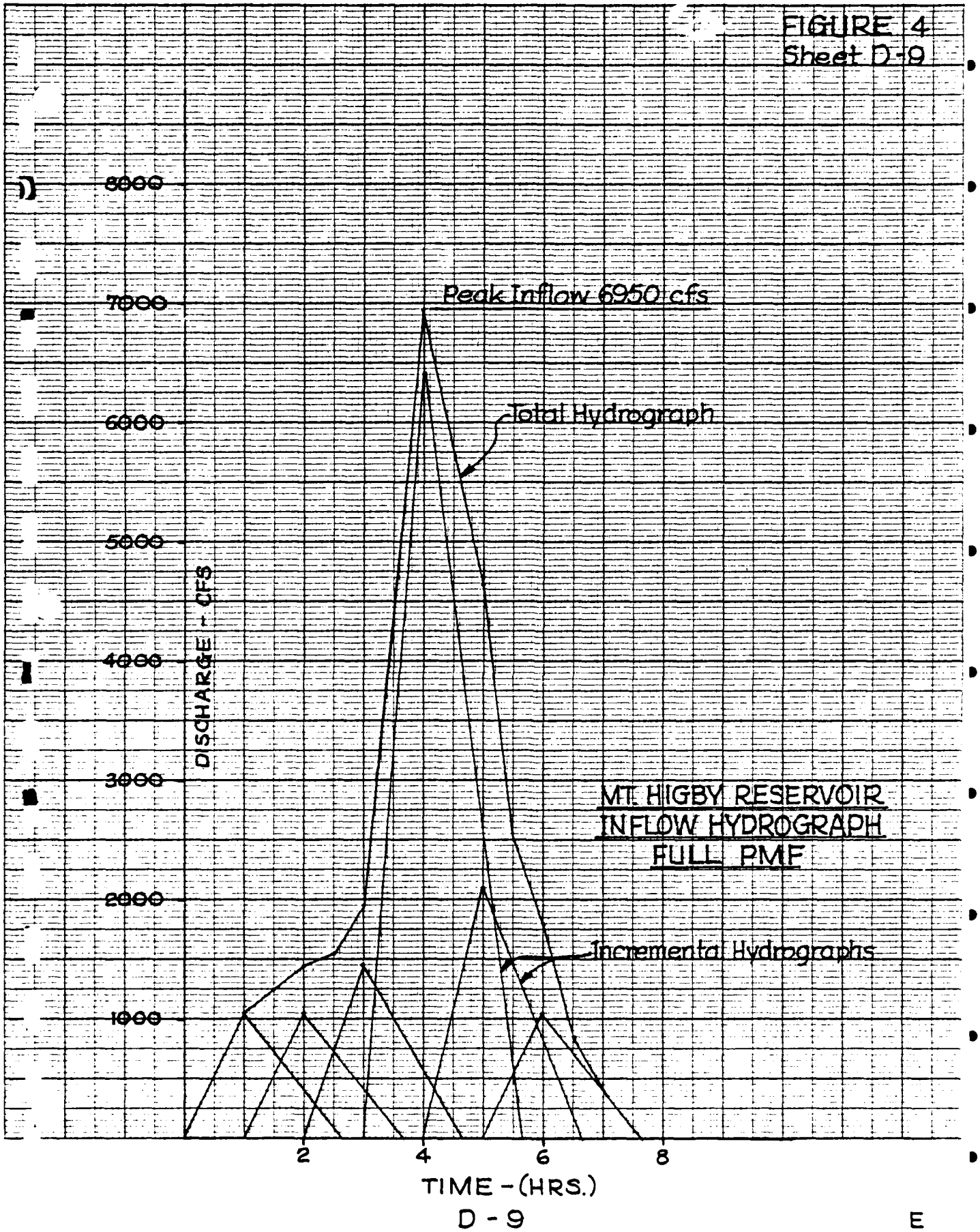
PMP = 24" × 0.8 (fit factor) = 19.2" for 6 hrs.

Adjust for Filtration Loss + 19.2 · 0.4 = 18.8"

TIME	RAIN DIST. (IN)	Q_p	Begin T	T of PEAK	T of END
0					
0.5	0.75	697	0	0.75	2.00
1.0	0.75	697	0.5	1.25	2.50
1.5	0.75	697	1.0	1.75	3.00
2.0	0.75	697	1.5	2.25	3.50
2.5	0.94	873	2.0	2.75	4.00
3.0	1.13	1050	2.5	3.25	4.50
3.5	3.57	3317	3.0	3.75	5.00
4.0	5.64	5240	3.5	4.25	5.50
4.5	1.69	1570	4.0	4.75	6.00
5.0	1.32	1226	4.5	5.25	6.50
5.5	0.75	697	5.0	5.75	7.00
6.0	0.75	697	5.5	6.25	7.50

TIME	RAIN DIST. (IN)	Q_p	Begin T	T of Peak	T of END
0					
1.0	1.50	1044	0	1.0	2.67
2.0	1.50	1044	1.0	2.0	3.67
3.0	2.07	1441	2.0	3.0	4.67
4.0	9.21	6410	3.0	4.0	5.67
5.0	3.01	2095	4.0	5.0	6.67
6.0	1.50	1044	5.0	6.0	7.67

FIGURE 4
Sheet D-9

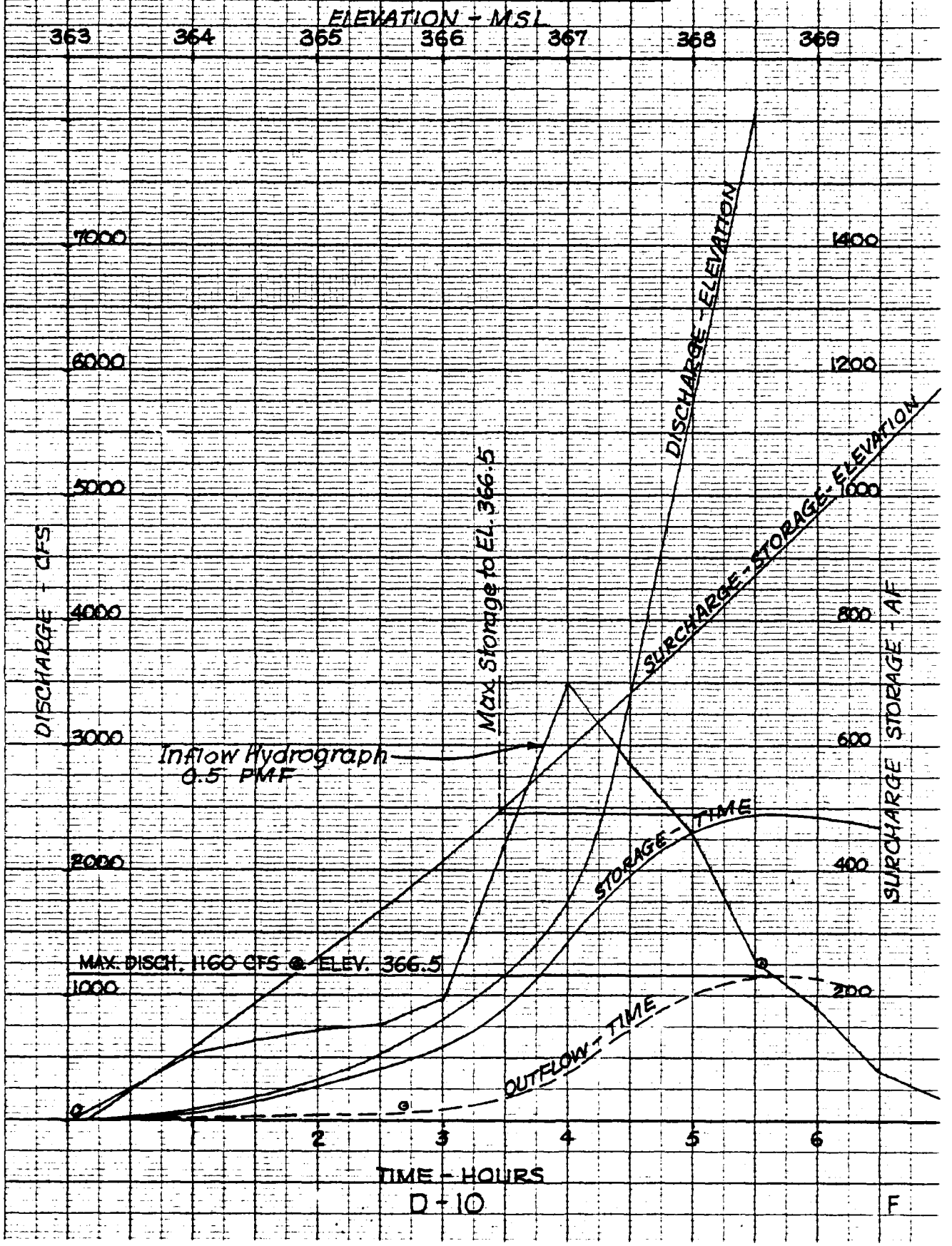


MT. HIGBY RESERVOIR
INFLOW HYDROGRAPH
FULL PMF

E

MT. HIGBY RESERVOIR DAM
RESERVOIR FLOOD ROUTING - 0.5 PMF

FIGURE 5
Sheet D-10



MT. HIGBY RESERVOIR DAM

FIGURE 6
Sheet D-11

1 sq. M = 82.6 A.F.

RESERVOIR FLOOD ROUTING - FULL PMF

ELEVATION - MSL

363 364 365 366 367 368 369

DISCHARGE - SEC. FT.

8000
7000
6000
5000
4000
3000
2000
1000

MAX. DIS. = 4800 CFS @ 367.8 MSL

Inflow Hydrograph — Full PMF

DISCHARGE-ELEVATION

SURCH. STORAGE-ELEV.

OUTFLOW-TIME

Outflow-time thru spillway and over dam

STORAGE-TIME

Outflow-time thru spillway

Volume of outflow over dam = 288 AF

SURCHARGE STORAGE - A.F.

1400
1200
1000
600
400
200

1 2 3 4 5 6 7

TIME - (HRS.)

STANDARD ® CROSS SECTION
10 X 10 TO THE HALF INCH

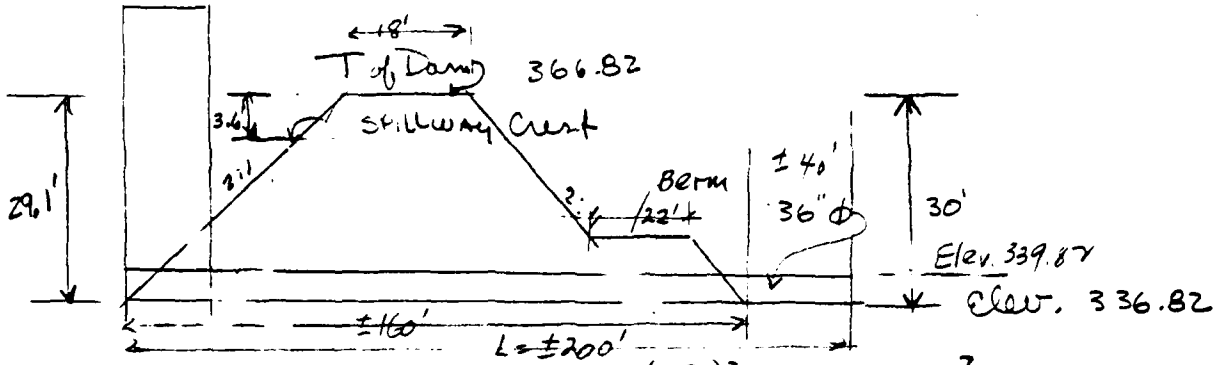
G

BY PEC DATE 2/2/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-12 OF

CHKD. BY DATE DAM INSPEC. PROJECT

SUBJECT MT. HIGBY RESERVOIR DAM

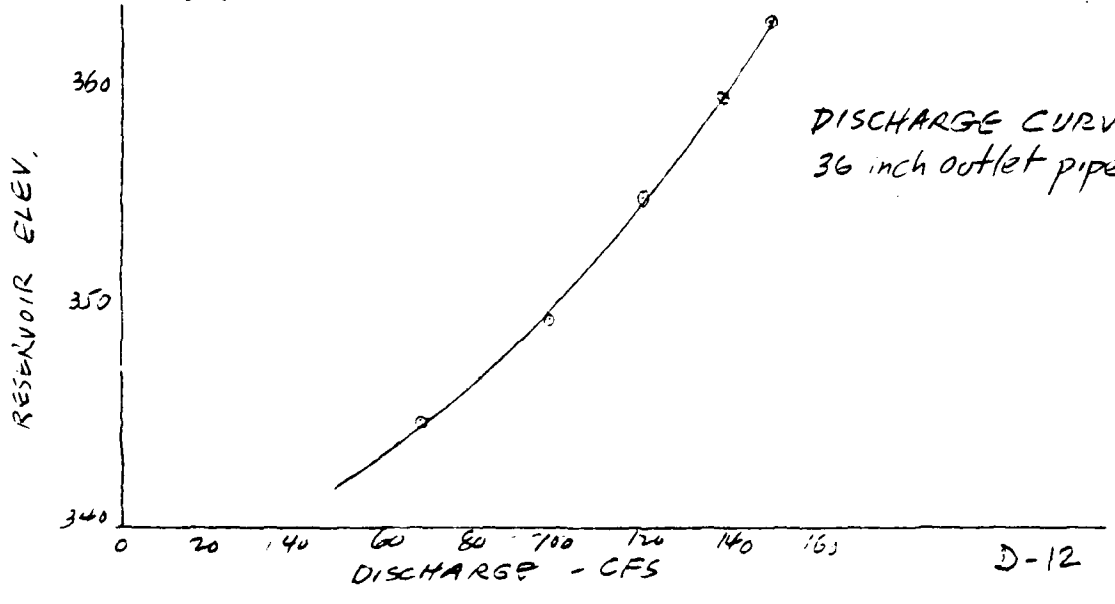
EVACUATION TIME OF RESERVOIR THRU OUTLETS



36" ϕ $A = \pi r^2 = \pi \left(\frac{18}{12}\right)^2 = 7.06\ ft^2$

Res. El	36" DISCHARGE H	L	Q* CFS	EVACUATION CFS Average Disch.	Average Disch/hr. A.F	Δ STOR	Evac. Time-HRS
363.2	23.4	200	156				
359.8	20.0	200	138	144	11.9	487	40.9
354.8	15.0	200	120	129	10.6	300	28.3
349.8	10.0	200	98	109	9.0	250	27.8
344.8	5.0	200	69	83.5	6.9	110	15.9
						1147	112.9 hrs = 4.7 days

* $Q = A\sqrt{\frac{2gH}{\Sigma k}}$ $\Sigma k = \underset{\text{Entrance}}{0.5} + \underset{\text{Exit}}{1.0} + \text{Friction}$ $\frac{fL}{D} = \frac{.028 \times 200}{3} = 1.86 = 3.35$



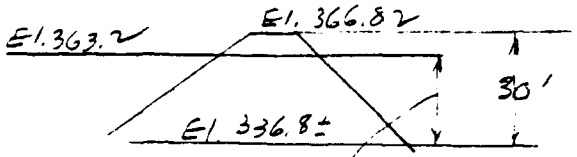
DISCHARGE CURVE
36 inch outlet pipe

BY CJH DATE 2-7-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-13 OF...

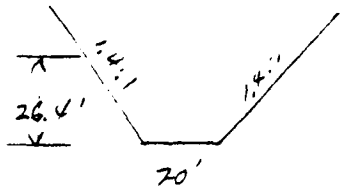
CHKD. BY ..... DATE ..... INSPECTION OF DAMS CONN. RI. PROJECT .....

SUBJECT MT. HIGBY RESERVOIR - HYDRAULICS

BREACH FAILURE OF DAM OWING TO STRUCTURAL INADEQUACY



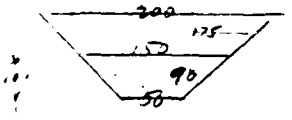
Gap depth 26.4'



Flood surge $Q = \frac{8}{27} W \sqrt{g} H_0^{3/2}$

Res Elev.	H	cfs/ft	ΔQ ΔH=20'	$\frac{\Delta Q}{\Delta H}$	ΔQ	ΣQ	Average Q	AF/min	Δ Storage AF	Evacuation time Minutes	HRs
363.2	26.4	228	4560	37.0	8436	13000					
360	23	185	3700	32.2	5957	9660	11330	15.6	380	24	
355	18	128	2560	25.2	3226	5790	7725	10.6	400	38	
350	13	79	1580	18.2	1438	3020	4405	6.1	250	41	
345	8	38	760	11.2	426	1186	2103	2.9	120	41	
340	3	9	180	4.2	38	218	702	1.0	20	20	
337	0	0	0	0		0	109	0.2			
										164'	2.7

STAGE-DISCHARGE IN FALL BROOK



$n = .075$ $S = \frac{150}{9200} = .016$ $S^{1/2} = .128$

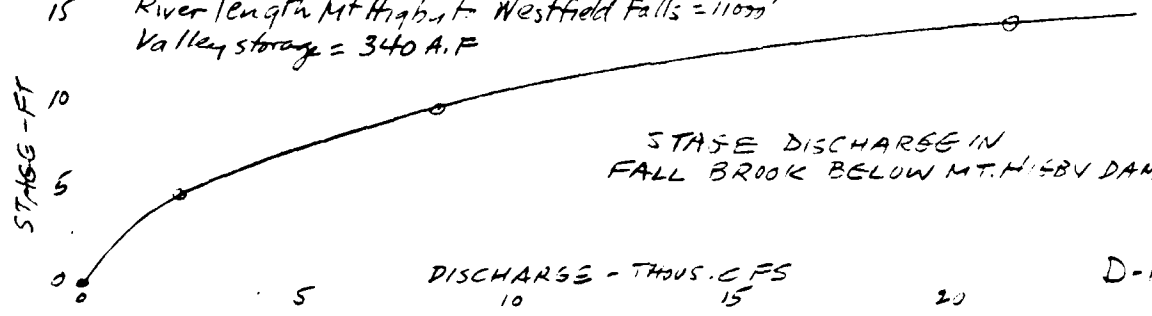
$Q = \frac{1.486}{n} A r^{2/3} S^{1/2} = 2.53 A r^{2/3}$

Depth	Width Channel	Δ Area	Σ Area	w.p	r	$r^{2/3}$	Q
0	50		0				
5	90	350	350	91.2	3.84	2.45	2170
10	150	600	950	152.0	6.25	3.39	8150
15	175	838	1788	178.9	9.99	4.64	20990
26	200	937	2725	205.8	13.24	5.60	38590

For Q = 13000 Stage = 12.5' A = ±1350

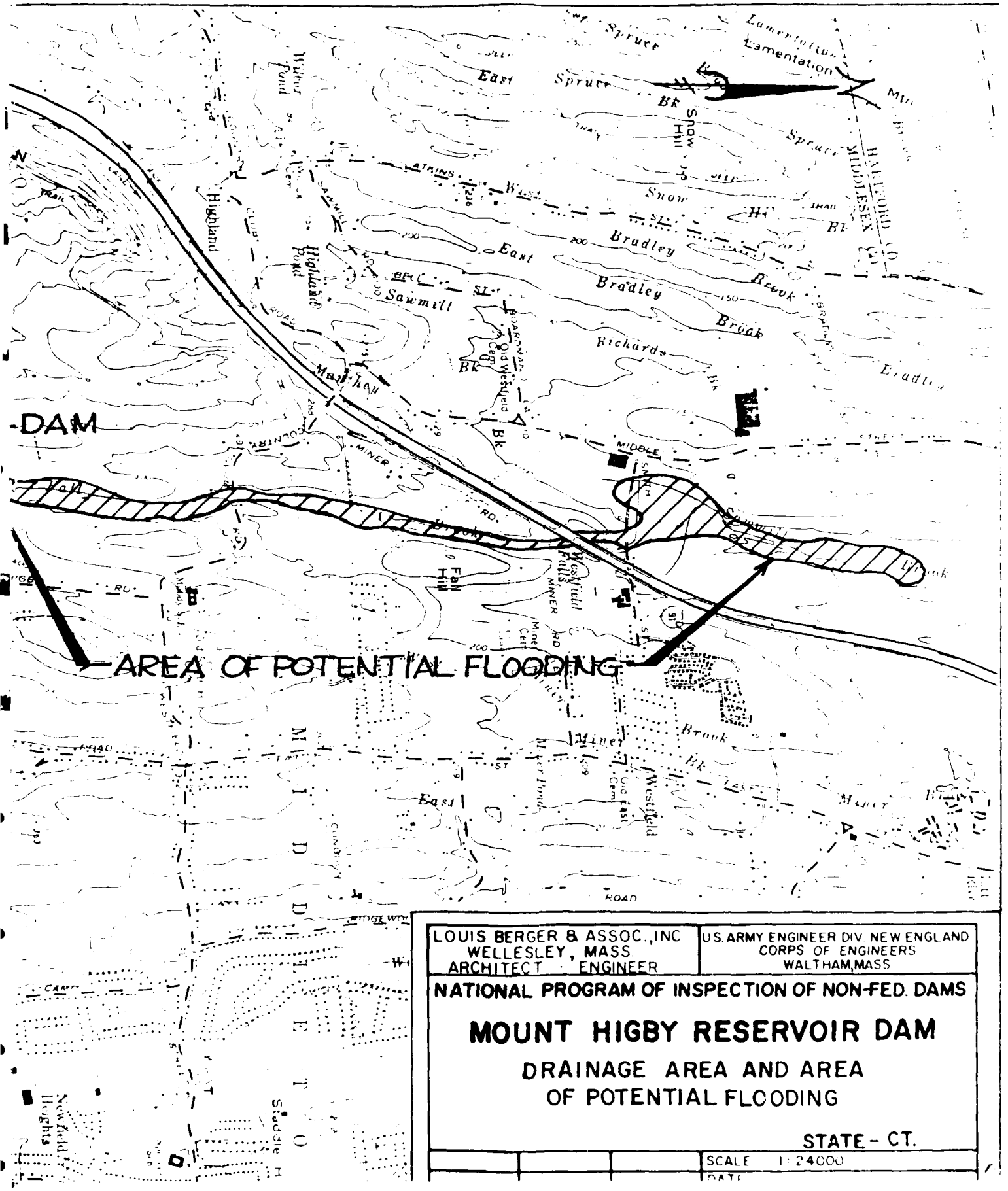
River length Mt Higby to Westfield Falls = 11000'

Valley storage = 340 A.F



STAGE DISCHARGE IN FALL BROOK BELOW MT. HIGBY DAM

D-13



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

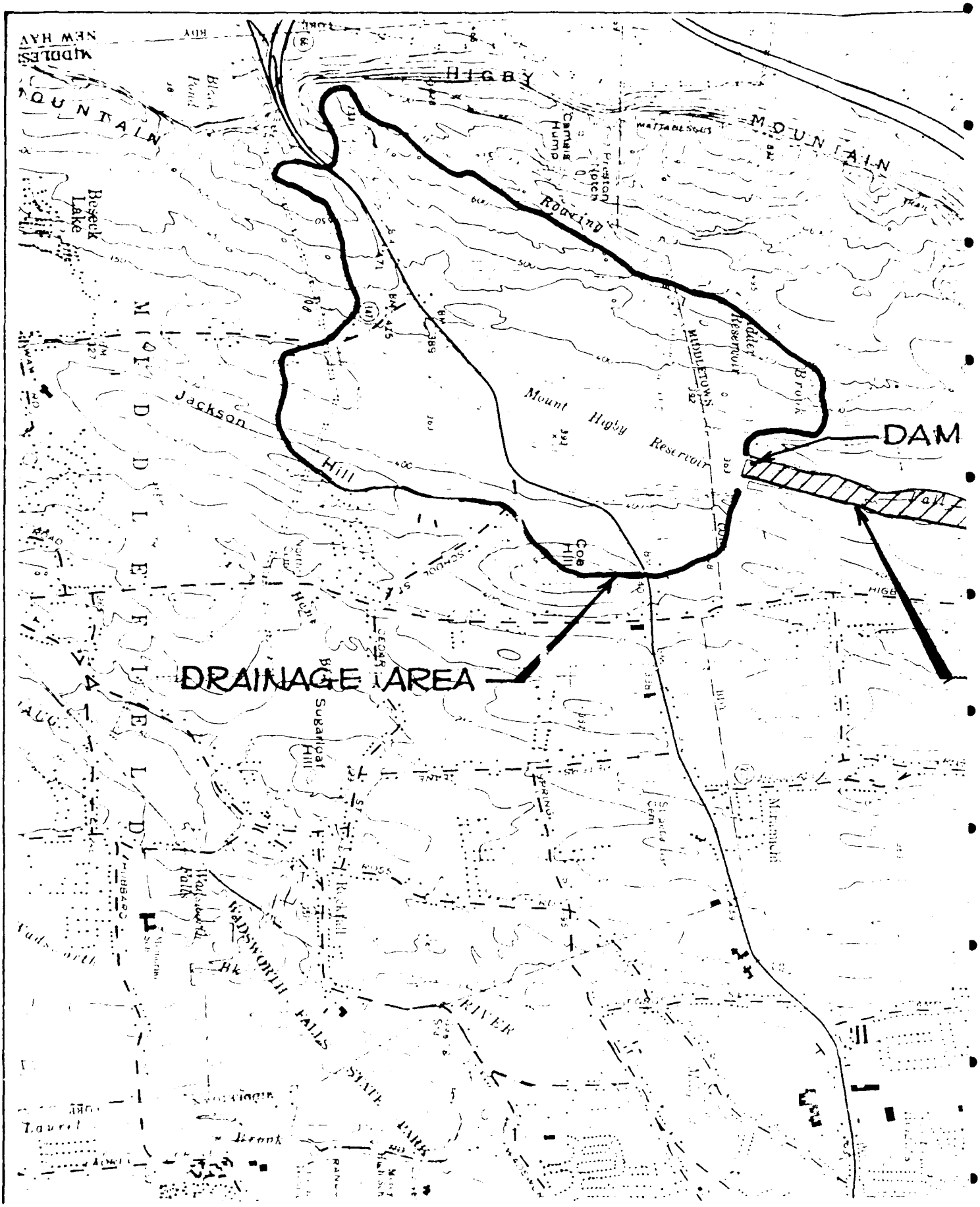
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

MOUNT HIGBY RESERVOIR DAM

DRAINAGE AREA AND AREA OF POTENTIAL FLOODING

STATE - CT.

			SCALE 1:24000
			DATE


DRAINAGE AREA
DAM
HIGBY
MOUNTAIN
Roaring
Brook
Mount Higby
Reservoir
Jackson
Hill
Coe
Hill
Beseck
Lake
Adler
Reservoir
MIDDLETOWN
MIDDLEFIELD
Sugarloaf
Hill
Wadsworth
Falls
RIVER
STATE
PARK
Laurel
Brook

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

END

FILMED